APPLIED HYDRAULICS

FEBRUARY 1956

THE MAGAZINE OF
FLUID POWER
INCLUDING AIR CONTROLS
AND AIR CIRCUIT DESIGNS
• ELECTRICAL CONTROLS •

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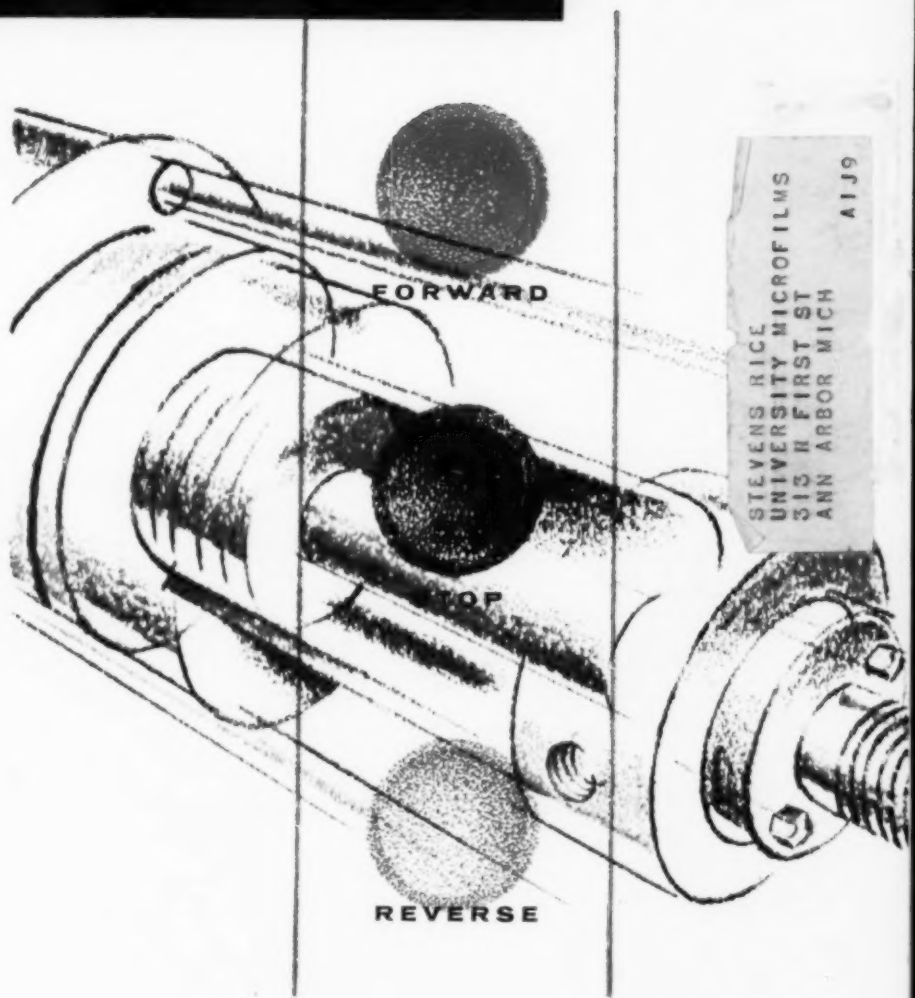

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Electrical Controls For Fluid Power

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the APPLIED HYDRAULICS 1956 Prize Paper Contest
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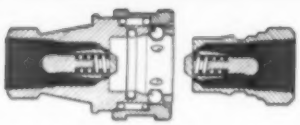

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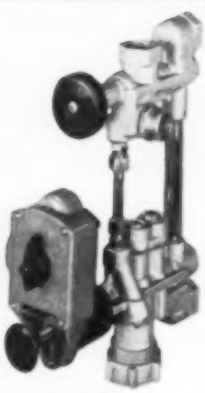

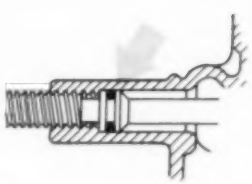

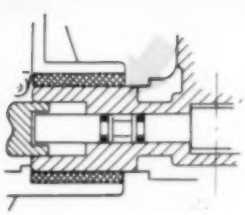

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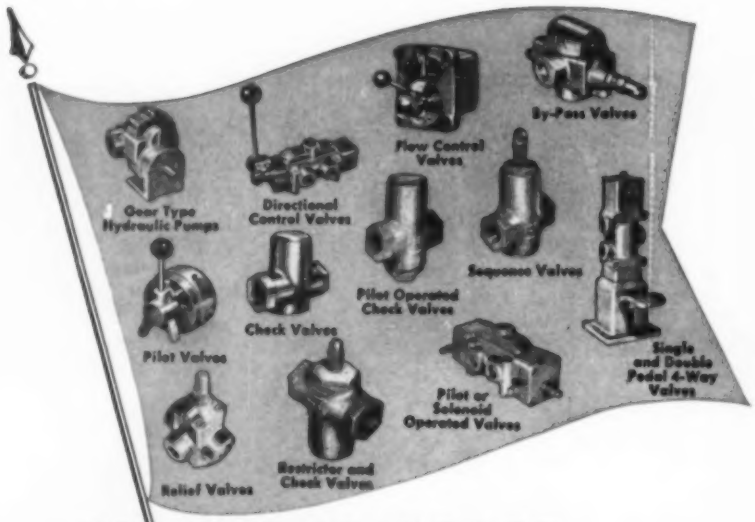

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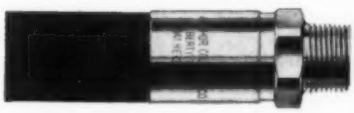

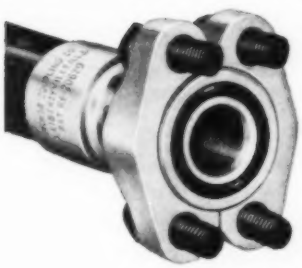

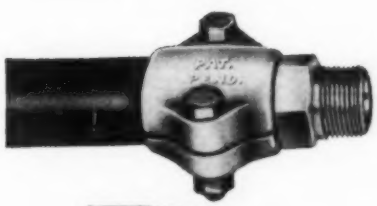

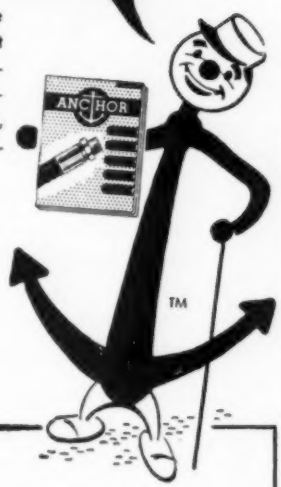

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Fluid Power Lines

about Applied Hydraulics

IF THERE'S A SOLENOID VALVE . . . in your air or oil circuit, you've got an electrical control circuit that can range from a simple control to a complex circuit involving relays, timers, and limit switches. The designer of fluid power circuits should understand the selection and application of these electrical controls which are used with air and oil circuits. This understanding will frequently permit him to design simpler, more flexible equipment and assist him in specifying proper components. To provide this information, associate editor Allan Morris has prepared a series of articles which begin in this issue. Starting with a general article on design procedures for a trouble-free, safe system, the series will discuss features and applications of motors, limit switches, pressure switches, timers, pushbutton control, relays, solenoid valves, and motor starters. Each article will treat a separate component outlining the available types and indicating typical circuit arrangements in which the component can be used.

WHAT ABOUT FLUID MOTORS? . . . For some reason, it seems that the possibilities for using rotary fluid motors are the least understood of any hydraulic component. To designers who have seldom used a fluid motor and to the user who has rarely encountered the fluid motor, Rex Burnham's article will prove very helpful.

EXPLOSION-PROOF OPERATION . . . Ask an engineer in a chemical plant, arsenal, or any plant where the hazard of explosion is present, how he would actuate hydraulic valves in an automatic system. Chances are that his answer will be, "With compressed air. Solenoids are taboo". We asked Johnny Pippenger, vice president of Double A Products Co., about this problem. What he told us supplies several answers to the control of valves in hazardous locations. You'll find them on page 47.

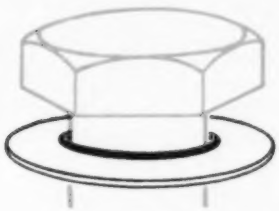
MEET AH's EUROPEAN EDITOR . . . John Lankester, who heads the Industrial Publishing Group's London office, has been a member of our staff since 1951. It's about time we introduced him. Actually, you've met him many times. He has written articles on the development of bonded seals and British aircraft pumps. Also, John reports on British technical meetings. In this issue, part 1 of a two part article details hydraulic servo devices on British aircraft.

John A. Lankester

John studied at The College of Aeronautical Engineering in London. In 1938, he joined Dowty Equipment Ltd. and did field service and installation of aircraft hydraulic systems. Service and repair of fighter aircraft and maintenance of hydraulic systems on large bombers kept him busy during the battle of Britain. He was chief instructor of the Dowty school of aircraft hydraulics.

After the war, he joined the editorial staff of Flight, the British aviation weekly. Before joining us he also served as technical representative for oil seals and glands.

end leakage...have lock washer action with Precision O Dyna-seals



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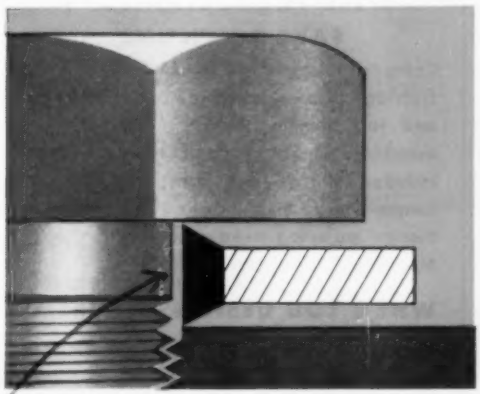
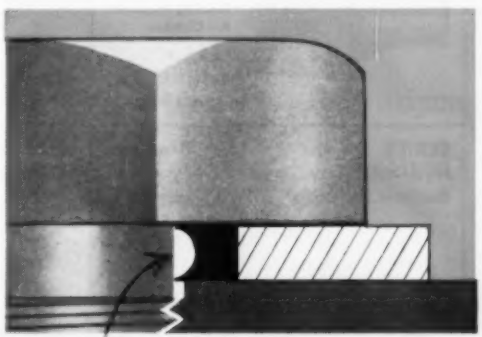
Dyna-seals permit face-to-face sealing with no grooves to cut or special machining of surface to be sealed. Here is simplicity in assembly that reduces fabrication costs and improves product appearance as well.

Use Dyna-seals on any flat surface under bolt or rivet heads, cap nuts, flanges, special fittings, etc. Let a Precision engineer work with you and demonstrate the advantages of putting Dyna-seals into your products.



Note flare of rubber sealing member. When compressed under any type of bolt, flange or screw, it provides positive lock washer action, and reduces bolting torque.



When pressure of bolt head is applied, sealing lips are forced against surface, forming a convex shape opposing steady or pulsating pressure. Dyna-seal provides positive sealing against leakage.

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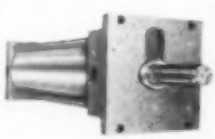

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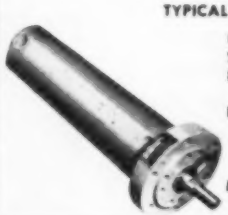
SERIES J—High Pressure Hydraulic Extra Heavy Duty Cylinder

TYPICAL APPLICATIONS

Feed Cylinders
Slide Cylinders
Die Casting Shot Cylinders
Drilling & Tapping Machines



Request Bulletin 53

SERIES S—Air or Low Pressure Hydraulic Extra Heavy Duty Automation Cylinder

TYPICAL APPLICATIONS

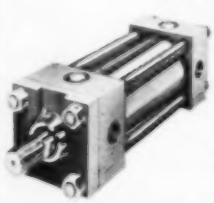
Clamping Fixtures
Welding Machines
Automation Equipment
Loading & Unloading Devices

Request Bulletin 55

SERIES N—High Pressure Hydraulic Heavy Duty Cylinder

TYPICAL APPLICATIONS

Feed Cylinders
Welding Machines
Die Casting Machines
General Machine Tools



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The ENGINEER'S Corner

In these days of automatic highspeed production, careful selection of each machinery component is of vital importance. This is particularly true in the choice of hydraulic or air cylinders. Failure of a cylinder to function at peak capacity not only means "downtime" of the machine itself but in most cases of an entire line. The quality of the product, the pressure rating and the ease of installation and simplification of maintenance are all factors to be considered in purchasing cylinders. Many cylinder manufacturers provide both square and round type cylinders in a wide variation of bore sizes for varying pressure ranges. Careful investigation of cylinder sources almost always results in a standard cylinder to meet the exact design requirements of the machinery involved.

Important checkpoints in selection of a cylinder include: a precision cylinder barrel bore . . . the *end caps* and *mountings* should be of solid steel to prevent breakage . . . the *ports* should be of adequate size and unobstructed for unrestricted flow . . . *cushion adjustment* and *ball retainer* should be accessible for easy maintenance. Interchangeability of cushion adjustment and cushion ball check is a desirable feature to look for . . . Cushion for most applications should be approximately 1" long with all mating parts machined to extremely close tolerances and provide for perfect alignment.

Pistons depending upon the application may consist of piston rings or a type of flared lip seal . . . *piston rods* for long life and resistance to scoring should be heat treated, stress relieved, ground, polished and hard chrome plated. . .

A recent development in cylinder design is a *removable cartridge gland* which permits removal of the entire *cartridge* without dismantling of the cylinder. This is a particularly desirable feature to look for . . . *rod ends* should be turned down past wrench flats to facilitate removal and replacement of cartridges without damaging lip of the seal.

As Chief Engineer for a leading manufacturer of air and hydraulic cylinders, a great deal of my own time is spent in research and development work. Although we have always maintained highest quality control standards within our plant we know that building the best today, may not mean we will be ahead of the field tomorrow. Thus, we constantly strive to add new features to make our product better to uphold the reputations of the customers we serve . . . who in turn must also keep ahead of obsolescence and competition.

Joseph L. Bosi

Hydro-Line Manufacturing Co.
Chief Engineer

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WORLD-WIDE REPRESENTATION

New Supergauge Movement Extends Gauge Life; Gives Users Many Extra Benefits

In the quest for longer gauge life under severe operating conditions, one of the principal hurdles confronting instrument engineers has been the problem of gear tooth wear. Many efforts have been made to solve this problem including the use of materials other than metal.

U. S. Gauge research indicated nylon rolling on stainless steel provided the best solution if proper control of the nylon were achieved. All past experience showed that expansion of the nylon when subjected to heat and humidity changed pitch diameter causing binding and wear. This destroyed the gear rolling action, thus defeating its main advantage of assuring longer gauge life under severe operating conditions.

Using a new approach to the problem, U. S. Gauge engineers developed the new *ARC-LOC movement.

Molded nylon is bonded to the face of the stainless steel segment to maintain pitch diameter. Gear teeth are then accurately generated on the nylon face to assure perfect rolling action on the stainless steel pinion. The segment gear face is broad and all bushings or pivots are deep to assure strength and ruggedness. The result is longer gauge life under severe operating conditions.

Since nylon is applied to the arc of the sector, any tendency of the nylon to grow or shrink occurs along the periphery instead of along the radius. Thus, accurate pitch diameter is maintained and there is no wear from binding. With this design, the smooth gear rolling action between segment and pinion continues even under adverse conditions of heat and humidity.

The new U. S. Gauge ARC-LOC movement also provides several additional features of interest to the user: For easier adjustment the complete movement can be rotated about the pinion axis, positioned properly and locked from the rear. This provides the advantage of linearity adjustment without removing dial and pointer. The unique locking method also eliminates creep during locking.

The Arc-tang segment allows range adjustment without resetting of the pointer.

These added advantages mean savings in time during calibration . . . an important factor in maintenance reduction.

For complete information on the savings that are made possible by U. S. Gauge's new Supergauges and Solfrunt gauges with the new ARC-LOC movement, write for Publication 1819.

*Trademark

UNITED STATES GAUGE

Gauge Headquarters
FOR OVER 50 YEARS

USG
UNITED STATES GAUGE
Division of American Machine and Metals, Inc., 111 Clymer Avenue, Sellersville, Pa.

LETTERS
to the editor

Needs an Air Cylinder

We are seeking a source for a seemingly hard-to-find item to be used as original equipment in a positioning device we are developing for the woodworking people. Our application calls for a single-acting air cylinder with heads welded or otherwise attached to provide an exterior free from protrusions in order to fit into our limited space. We require a 7 inch bore, 15 inch stroke, 135 psi max pressure.

Because of the comparatively crude nature of our device and the necessity of holding the selling price to a minimum, we have felt that cylinders of the general class and quality of those being used in automobile bumper jacks would best suit our purpose.

It may be necessary for us to make our own cylinder, but we would prefer to buy these from a firm specializing in this type of product.

H. J. HULSART
Dexter D. Hulsart Co.
Tuscaloosa, Ala.

There are a number of manufacturers of air cylinders who can meet your requirements for size. You can determine if they can do it at a price which is suitable for your product by requesting information from the list of companies we have sent to you.

"Revolutionary" Auto

Recently, news bulletins have announced that England's Mr. Ferguson has come up with a hydraulically-powered automobile. Have there been articles in APPLIED HYDRAULICS or do you anticipate publishing an article on this "revolutionary" auto in the near future?

A. W. BITZER
Caterpillar Tractor Co.
York, Pa.

We have asked our European editor to investigate the application of hydraulics on the recently announced design by Harry Fer-

Eastman HYDRAULIC HOSE ASSEMBLIES

DELIVER MOBILE POWER *for* ALLIS-CHALMERS

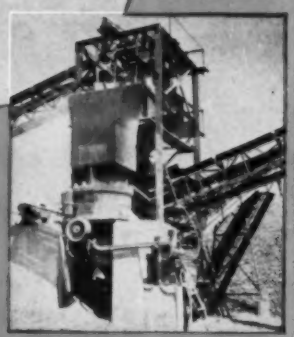
"AD-40" Motor Grader

"TS-300" Motor Scraper

Eastman Hydraulic Hose Assemblies used on steering ram of Allis-Chalmers TS-300 and TS-360 Motor Scraper. Also used on TS-200 Series to control steering, plus apron, ejector and bowl action—applying down pressure when loading equal to the weight of the scraper—38,560 lbs.!

ALL-CROP Harvester

"WD-45" Tractor



HYDROCONE Crusher

GLACIERS NEVER HAD IT SO EASY . . .

The millions of years required by the glaciers to scour and alter the earth diminish to mere minutes when Allis-Chalmers earth moving and grading machinery go to work. Many of these mighty machines owe much of their ease of operation and maneuverability to hydraulic power—delivered through **EASTMAN** Hydraulic Hose Assemblies.

TODAY'S FARM YOUTH NEVER BORN "30 YEARS TOO SOON"

Milestones in farm mechanization are marked by Allis-Chalmers farm machinery. Pioneering in many farming innovations resulted in such exclusive firsts as the ROTO-BALER, ALL-CROP Harvester, Rear-Engine Tractor—Power Shift Wheels, SNAP-COUPLER and Hydraulic Traction Booster. Much of the operation and control of this world famous line of farm machinery is done through hydraulic power—also applied through **EASTMAN** Hydraulic Hose Assemblies.

NATURE NEVER CRUSHED ROCK LIKE THIS . . .

Hydraulic power on the HYDROCONE crusher affords "one man, one minute" product size control. It provides a rapid and convenient means of raising or lowering the crushing head. It permits compensation for wear and facilitates emptying the crushing chamber in case of power failure or for the quick release of uncrushable materials. Allis-Chalmers pioneered in this type of crusher—as **EASTMAN** pioneered in Hydraulic Hose Assemblies.

TURN TO EASTMAN for *your* Hydraulic Hose Assemblies, too. Whatever your requirements, always get your first recommendation from **EASTMAN** . . . *first in the field.* Exclusive designs, advanced engineering, unequalled production facilities and efficiency—mean unequalled economy, performance and constant customer satisfaction for you.

Eastman

first in the field

SAFEGUARDING INDUSTRY'S *Lifelines of Mobile Power*

EASTMAN MANUFACTURING CO.
Since 1914
Dept. AH-2, Manitowoc, Wisconsin

WRITE *for free Catalog 101 on Eastman Hose Assemblies*

New NP "Power Package"

. . . gives you speedy response plus precise regulation and low cost!

Only *NP* offers this "Power Package" . . . complete with power drive cylinder, power check combined with a systems mounting kit as well as foot, pivot or flange mounting kits. It combines the speed and dependability of airpower with smoother regulation; yet, it's less expensive than fully hydraulic systems.

NP "System Mounting" provides simplified installation—easy application to both standard and special drilling, milling, reaming and grinding machines and many others. Look into *all* the advantages of the new *NP* "Power Package" today—it can help you improve quality, eliminate tool breakage and lengthen the life of valuable tools.

NEW NP POWER DRIVE CYLINDER

with all the "most wanted" design features

Exceptional adaptability—fast change-over Adjustable cushioning
Operable with air, water or oil—without changing parts.
Compact, streamlined design Lightweight alloy and steel construction

RATINGS:
Air—200 psi; water or oil—500 psi; Bore diameters: 1½", 2¼", 3", 4".

NATIONAL PNEUMATIC CO., INC. AND **HOLTZER-CABOT** DIVISIONS

Mail this coupon today for data sheets

INDUSTRIAL ACTUATORS AND CONTROLS DIVISION
NATIONAL PNEUMATIC CO., INC.
125 Amory Street, Boston 19, Massachusetts

Gentlemen: Please send me complete information on the NP "Power Package" ☐. Also include information on the NP Power Check ☐, NP Power Trol Valves ☐.

Name _____

Title _____

Company _____

Street _____

City _____ Zone _____ State _____

LETTERS to the editor

guson. According to our latest information this design does NOT include a hydraulic drive mechanism. First announcements had indicated that this new auto was to have individual fluid drives at each wheel similar to one of the ideas proposed for the never to be born Tucker automobile.

High Temperature Fluids

In your December issue, you did a fine job of reporting the SAE aircraft committee meetings. There is one statement, however, under "High Temperature Hydraulic Systems—400F" which states:

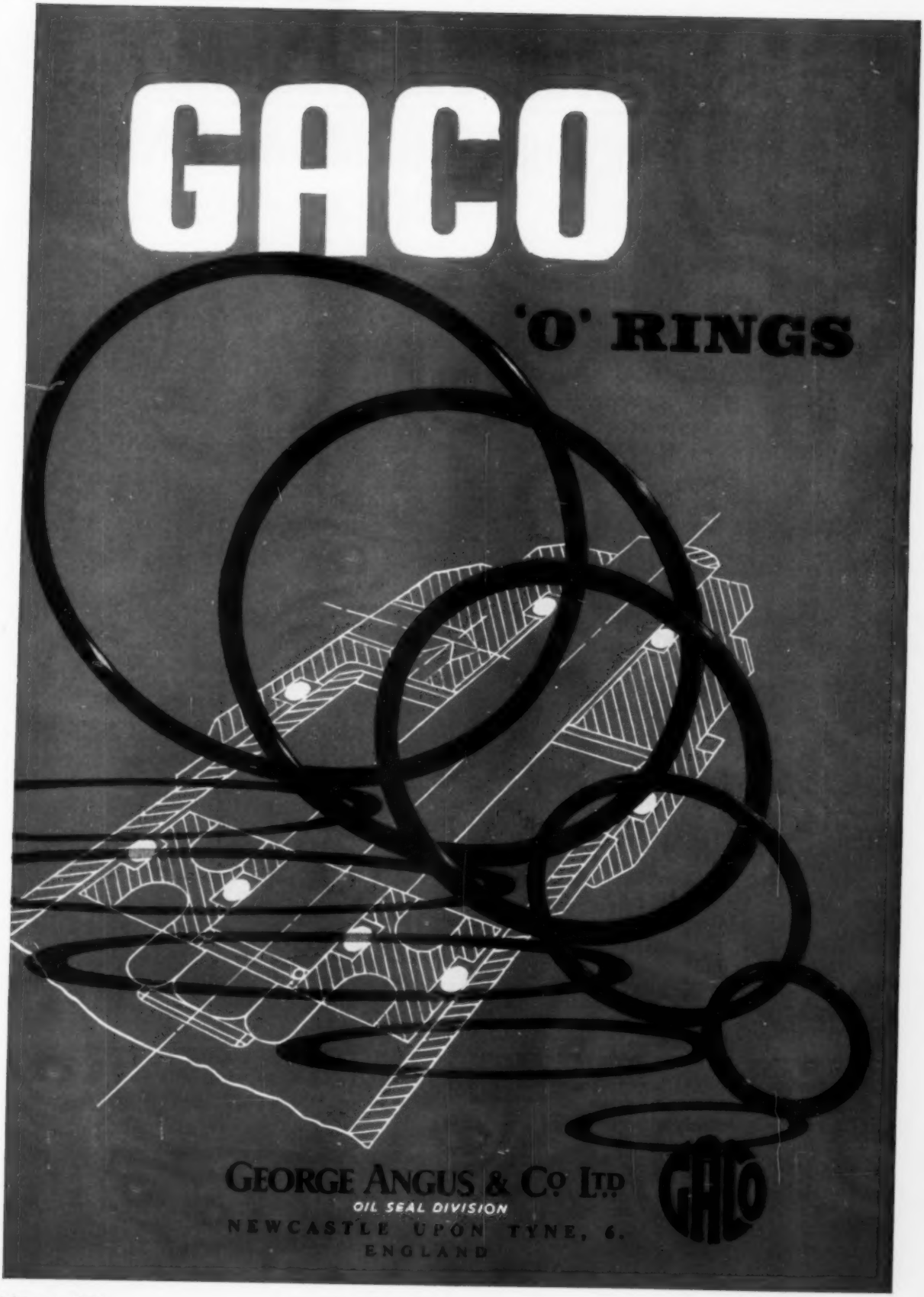
> The North American, Downey, representative reviewed their experience and efforts to meet this spec (MIL-H-8446, High Temperature Fluid, —65 to 400F). One series of tests were made with a modified OS-45 fluid using neoprene W O-rings.

This statement is factually correct. The fluid that North American is using, namely OS-45-1, is a modification of OS-45; however, I am afraid that some of the industry representatives will perhaps misconstrue the statement to mean that we have modified OS-45 in a manner similar to the MLO-8200 modification. This is not so. We are presently offering only the two fluids, OS-45 and OS-45-1. We frankly admit that we have caused our own confusion and that life would be much simpler had we renumbered the OS-45-1; however, it is too late now.

OS-45 and OS-45-1 are established high temperature hydraulic fluids, have been for four years, and we have no intention of modifying either formulation. Further, to help eliminate some of the confusion, we have chosen to recommend OS-45 for applications from —65F to +400F, and OS-45-1 for applications that will reach high temperatures perhaps in the range of 550F to 600F for short periods of time. These high temperatures are the reason for North American using OS-45-1.

H. STUART LITZSINGER
Development Department
Monsanto Chemical Company
St. Louis 1, Mo.

▼▼▼


GACO
'O' RINGS
GEORGE ANGUS & Co LTD
OIL SEAL DIVISION
NEWCASTLE UPON TYNE, 6.
ENGLAND
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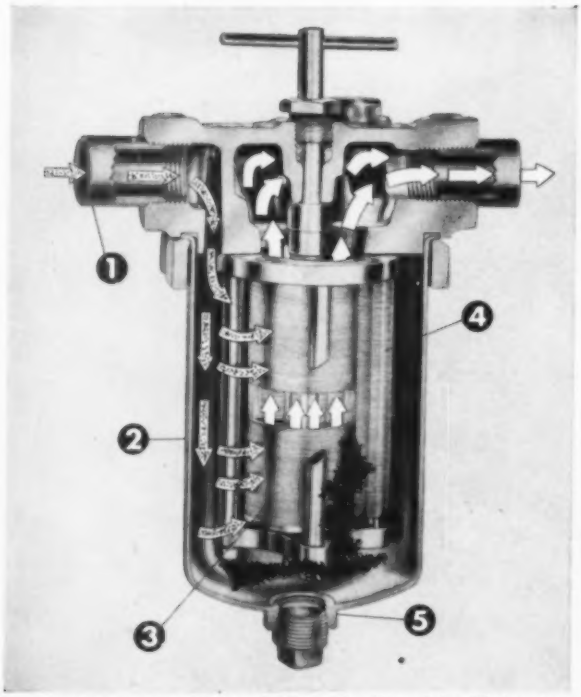
NOW! 40-micron, self-cleaning filter

It's the new Cuno SUPER Auto-Klean



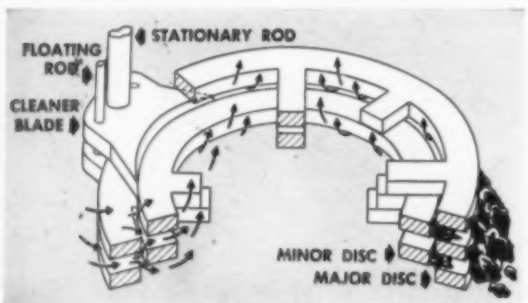
HOW IT WORKS. Dirty oil enters inlet (1) at left, fills housing (2) and flows through metal edge-type filter (3). Clean oil rises through center of filter, leaves at right. Dirt combed out by cleaner blades (4) is removed through drain (5).

Cuno's new SUPER Auto-Klean is the first practical, compact micronic filter for lubricating oil, hydraulic fluid, coolant, fuel, and other industrial fluids.

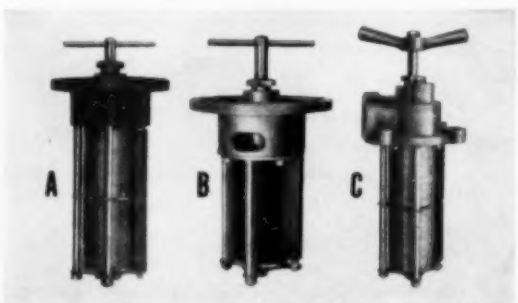
Many times smaller than other micronic filters of equal capacity, Cuno's new SUPER Auto-Klean filter now makes possible economical, micronic filtration at high flow rates and eliminates the need for replacement cartridges in most cases. Here's what it offers:

1. **Full-flow** 40-micron filtration with a self-cleaning filter. Positive protection against particles larger than 40 microns (actually 0.0015 in.). All-metal filter can't rupture or channel.
2. **Easy cleaning.** Just turn the handle—by hand or continuously with motor drive. No interruptions for cleaning.
3. **No cartridge changes.** Ends operating costs if you've been using cartridge filters.
4. **Low pressure drop, no pressure drop build-up.** An 8" by 2¼" SUPER Auto-Klean filters 30 gpm of 200 SSU oil with only 3 psi pressure drop—up to 75% more with slightly higher pressure.
5. **High capacity in a small package.** Many times smaller than replaceable-cartridge type filters of equal capacity, it saves with lower initial costs, lower installation costs.
6. **Easy to build into new equipment.** Available for line-type housings *(left)* or incorporation in sump or reservoir *(below.)* Works in any position.
7. **Easy to install in old equipment.** Fits existing Auto-Klean housings. You can easily replace most 2¼" diameter elements with SUPER Auto-Klean for finer filtration.

Write today for complete technical data on the new SUPER Auto-Klean for your new or existing equipment. Ask for Catalog No. SAK-057. Cuno Engineering Corporation, 2-2 South Vine Street, Meriden, Connecticut. 5.9



FILTER ELEMENT consists of stacked major and minor discs and cleaner blade bearing against minor discs. Small arrows show flow. Short restrictions between minor and major discs stop 40-micron particles but allow high flow rate.



FILTERS FOR INTERNAL PIPING *(A and B above)* allow streamlined design plus the best infiltration. Flange mounting with external outlet *(C above)* and line-type *(large cutaway above left)* are just a few of many other possibilities.

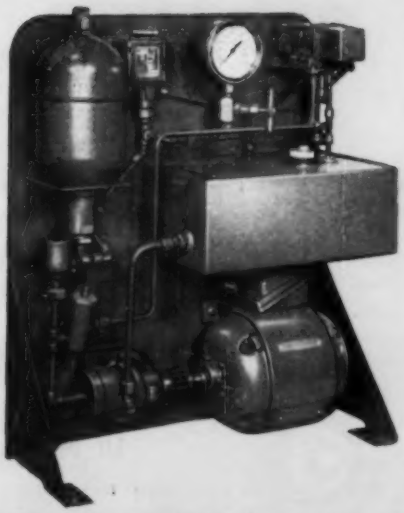
CUNO **ENGINEERED FILTRATION**

Removes More Sizes of Solids From More Kinds of Fluids

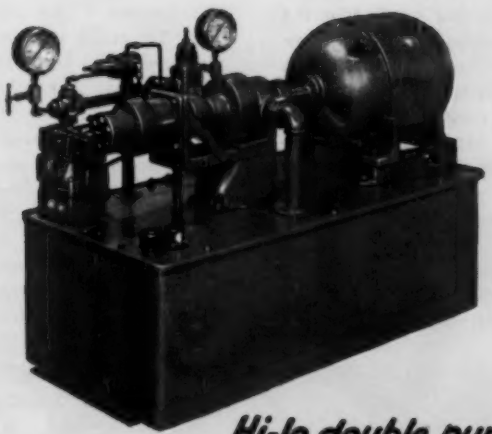
AUTO-KLEAN (edge-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound) • PORO-KLEAN (porous metal)

WHICH POWER UNIT DO YOU NEED?

Standard?



Panel mounted package?



Hi-lo double pump?

RIVETT can supply the exact power unit to meet your requirements!

STANDARDS are available in 17 models at continuous working pressures up to 1000 P.S.I. and 1500 P.S.I. Single pumps are offered in six tank sizes. Capacities from .4 to 40 G.P.M. Double pumps are offered in four tank sizes with combined capacities from 3.5 to 80 G.P.M.

CUSTOM-BUILT POWER UNITS are offered for pressures up to 5000 P.S.I. They are designed to accommodate unusual requirements of space, size, piping, valving, mounting, or operation.

See Rivett Power Units at Booth 324 A.S.T.E. Show, Chicago, March 19-23.

The better you know hydraulics — the better you like

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H. P. requirements, specifications, drawings fill this easy-to-use booklet. Write for free copy today!

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Representatives In All Principal Cities

RIVETT **furnishes a complete power package**

AIR AND HYDRAULIC — VALVES, CYLINDERS, POWER UNITS

Member — National Fluid Power Association

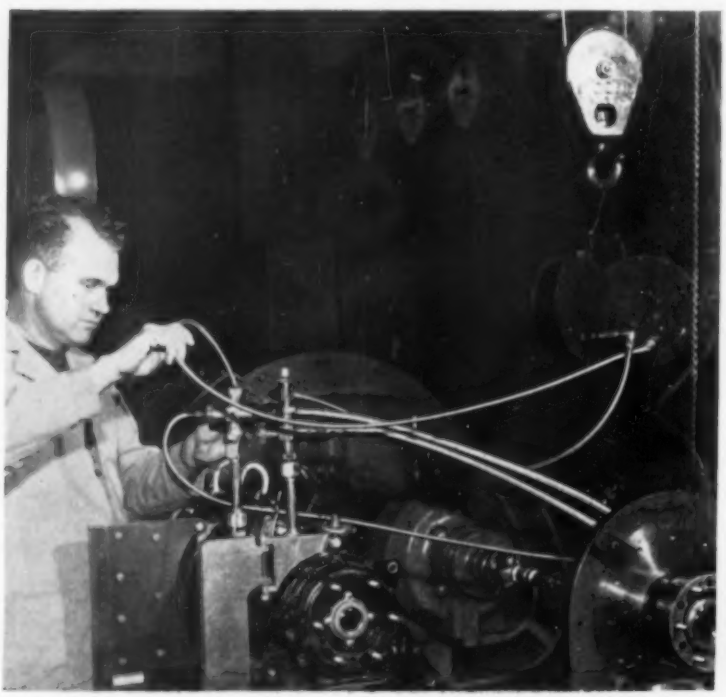
BRIEFS about fluid power

SPECIAL HYDRAULIC HOSE SOLVES TEST PROBLEM

Hydraulic constant speed drives, which are applied to the latest jet engines for driving constant frequency alternators, must be thoroughly tested prior to shipment and also upon overhaul. Sundstrand Machine Tool Company's Aviation Division, manufacturer of these drives, developed special test stands for this purpose.

During tests, MIL-O-7808 synthetic hydraulic fluid is circulated at temperatures up to 250 degrees F for production tests and up to 350 degrees F for experimental tests. To avoid contamination of these units, the fluid must be kept clean. Several types of hose materials were tested for this application, but none proved adequate. The hose started to erode within a short time and replacement costs were very high.

The solution was found in a hose made of fluorocarbon resin of special manufacture. Produced by Resistoflex Corporation, this hose has high corrosion resistance, can withstand temperatures up to 450 degrees F and is unaffected by all oils and fuels. It is supplied with a jacket of stainless steel armor braid, and together with fittings which can be swaged right over the armor, the hose assembly is rated at 1000 psi working pressure. ▼▼▼



New Device For Pre-Testing Resiliency Of Materials

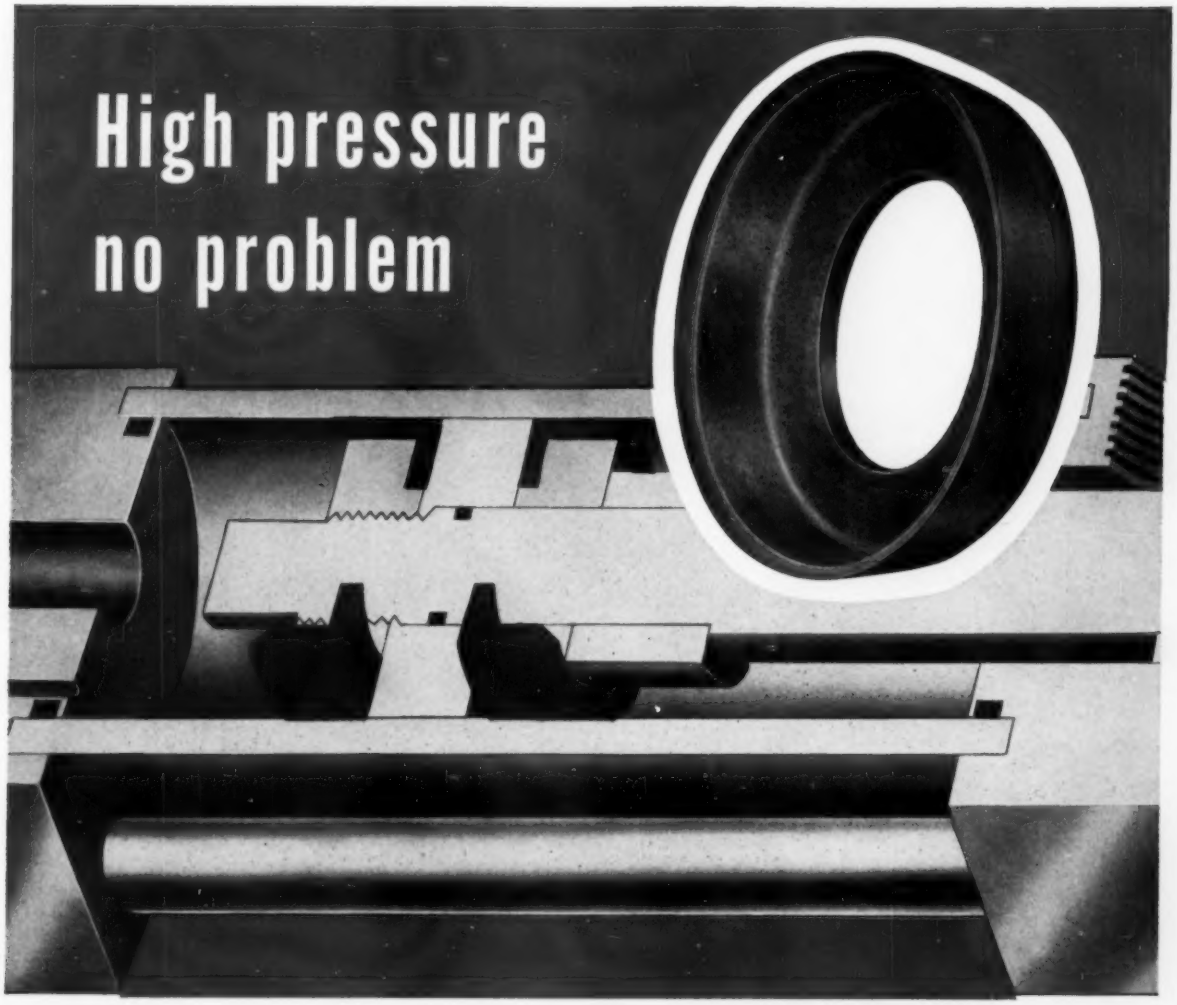
To determine temperatures at which a synthetic rubber or other resilient material recovers elasticity after being frozen to temperatures of —80 to —100 degrees F, Precision Rubber Products Corporation has perfected a TR tester. The unit is used to establish O-ring performance in low temperature conditions found in various applications. This low temperature testing gives assurance that O-rings will provide safety and service in the many industrial and aircraft applications, whether operated in extreme cold or warmer climates. ▼▼▼

A Final Report . . .

. . . about the 11th National Conference on Industrial Hydraulics, held last October in Chicago, tells that 110 industrial organizations contributed funds during 1955 to the NCIH and that a total of 671 persons registered for the two day meeitng. The 21 papers

Continued on page 20

High pressure no problem



SIRVIS-CONPOR PACKS IN A BIG PUSH

Got a high pressure problem? Maybe we can help. Chicago Rawhide's Conpor impregnated Sirvis leather packings are doing an outstanding job at pressures up to 10,000 psi. They are insoluble in most hydraulic fluids and are compatible with a wide range of other oils, solvents and gases. Sirvis-Conpor packings do not score cylinders, do not "chatter." The impregnations have no true melting point and will operate from as high as 225° down to –65° F. Sirvis-Conpor packings have high tensile strength, excellent resiliency, and operate without undesirable leakage. No other sealing material combines these advantages with long service life at such low cost. Let C/R engineers show you how to solve your hydraulic and pneumatic sealing problems with Sirvis-Conpor packings.

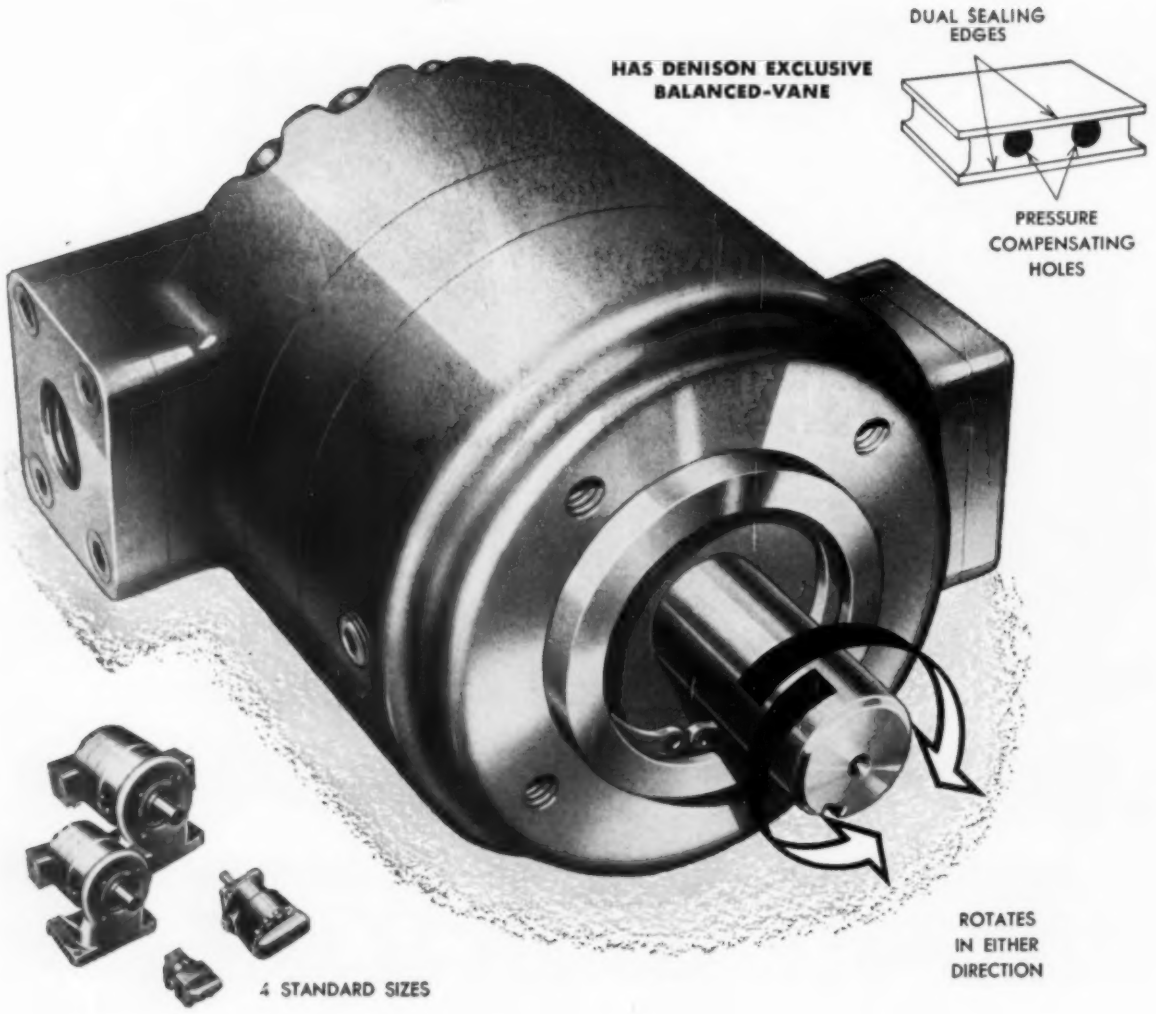
Send for "Report on Conpor."

CHICAGO RAWHIDE MANUFACTURING COMPANY
1203 Elston Avenue • Chicago 22, Illinois

Offices in 55 principal cities. See your telephone book.
In Canada: Distributed by Super Oil Seal Mfg. Co., Ltd., Hamilton, Ontario
Export Sales: Geon International Corp., Great Neck, New York

SIRVIS C/R DIVISION
CHICAGO RAWHIDE

OTHER C/R PRODUCTS
C/R Shaft & End Face Seals • Sirvene (synthetic rubber) molded pliable parts • C/R Non-metallic Gears



for continuous 2000 psi service...

Vane type Denison hydraulic single stage, Pump/Motor

IT'S A PUMP—high delivery in a small, compact package . . . a continuous 2000 psi pump.

IT'S A MOTOR—high stalled torque up to 257 pound-inches per 100 psi. Takes high shock pressures without danger.

EXCLUSIVE—Denison *Radially Balanced* Vane; *Cuts wear* between cam ring and vane; *Increases efficiency* with dual sealing edges; *Reduces pulsation* by radial pumping action of vanes.

SIMPLIFIES INVENTORY

No need to stock separate pumps and motors. Runs as a pump or motor without alterations. Range of capacities in each size through interchangeable cam rings.

EITHER DIRECTION—Operates efficiently as a pump or motor without change in piping. Minimum internal friction in either direction because of greatly reduced contact pressure between vanes and cam ring.

STANDARD SIZES—as a pump, Range of delivery 2.5 to 77 gallons per minute at 2000 psi.
As a motor, Horsepower output 1 to 103 hp at 2000 psi.

MORE INFORMATION—Send for Bulletin P-5-A giving complete specifications. Write . . .

THE DENISON ENGINEERING COMPANY
1160 Dublin Road • Columbus 16, Ohio
A Subsidiary of American Brake Shoe Co.

DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

Circle 31 on Reader Service Card

Why limit yourself to "STOCK" sizes?

Hannifin can ship the cylinder you need within 48 hours!

(NEW AND EXPANDED PRODUCTION FACILITIES MAKE THIS POSSIBLE)

Any mounting style in:

Series "A" Square Head Air Cylinders—1½" to 14" bore
Series "H" Square Head Hydraulic Cylinders—1½" to 8" bore
Series "LW" Cast Head Air Cylinders—1" to 12" bore

Strokes
As specified to 60"

Rod Ends
Catalog standards, including standard alternates.
Most special rod ends require only 24 hours longer.

Cushions
Either or both ends if required

Quantity
Normally any quantity you need for rush jobs.
For large quantities specify your requirements.

order by phone
When the need is urgent
call long distance.
Experienced sales engineers
will handle your order

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Air and Hydraulic Cylinders • Hydraulic Power Units • Pneumatic and Hydraulic Presses • Air Control Valves

When the pressure's on

your best bet is

FLEX-O-TUBE

If you use flexible hose in your product or for replacement in your plant, it will pay you to specify Flex-O-Tube. For here is a name that has stood for finest quality and dependable service for more than a quarter of a century.

In the development of new uses for flexible hose, Flex-O-Tube provides you with dependable experience in the field. When used for replacement in industrial maintenance, Flex-O-Tube provides you with a complete range of products that are easy to assemble and long on performance.

Whatever your needs, why not discuss them with the local Flex-O-Tube field engineer. You'll find there are many good reasons why industry has relied on Flex-O-Tube for miles and miles of flexible hose products.

Supplied in Assemblies

Flex-O-Tube will help you determine the assembly needed or work to your own specifications. In either case, modern facilities and latest inspection techniques assure you a uniformly high quality product delivered promptly.

Supplied for Field Assembly

Flex-O-Tube hose is also supplied in bulk coils with reusable fittings for field assembly. Complete range of sizes and types.

Please send me your free ☐ aircraft catalog. ☐ industrial catalog.

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DIVISION OF MERIDAN CORP.

2527 JIM DALY ROAD • INKSTER, MICHIGAN

Flex-O-Tube Co. (Canada) Ltd., Windsor, Ontario

BRIEFS / continued

read at ten technical sessions will be available in Volume IX of the Annual Proceedings. Ready for distribution this month, a copy will be sent to each industrial sponsor, and extra copies may be purchased at $5.00 each. This year's edition will be a 350 page, illustrated, case-bound volume.

Plans for the 1956 Conference —to be held October 18-19, at the Sherman Hotel, Chicago—are well under way. R. O. Isenbarger, chief engineer, Chicago Rawhide Mfg. Co., this year's director will appreciate suggestions as to subjects and speakers. ▼▼▼

Hydraulics With The Human Touch

Edward J. Hrdlicka, general manager of the Hydreco Division of the New York Air Brake Company, Cleveland, was recently honored as "Boss of the Year", by the Forest City Chapter of the National Secretaries Association.

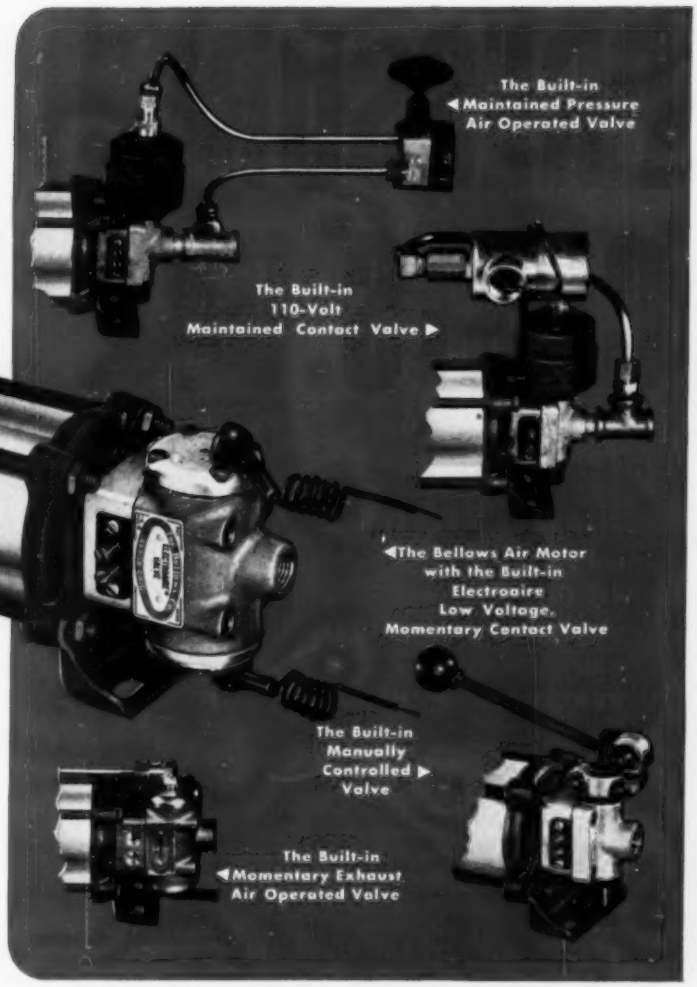
Edward J. Hrdlicka and his secretary Mrs. Jean Huffington.

Ed Hrdlicka, who according to his secretary is a wonderful man to work for, graduated from Fenn College in 1938. While still a student, he worked for the Hydraulic Equipment Co., and rose from the ranks to executive vice president. When in 1952 the company became the Hydreco Division of New York Air Brake Co., Hrdlicka was named general manager.

Besides his many duties as "boss", husband and parent, Hrdlicka has also found time to contribute articles on fluid power problems to the pages of APPLIED HYDRAULICS. ▼▼▼

Continued on page 22

The Bellows AIR MOTOR



is now available with your choice of built-in valve arrangements

IN DESIGNING for pneumatic operation of equipment, the air engineer can now choose the method of valving he prefers — and still have all the advantages of integral valve and cylinder construction.

The Bellows Air Motor — the only air cylinder with an integral valve—proven in over 150,000 installations —is now available with a range of built-in valve controls that offers the engineer every latitude in pneumatic design.

If he prefers to use momentary contact low voltage control, standard or explosion-proof, Bellows has it. If he prefers 110 volt maintained contact for interlock with established electrical circuits, Bellows has it. If he prefers to control his pneumatic circuits manually, Bellows has it. Or should his designs call for full pneumatically controlled operations, Bellows offers a choice of two control systems.

Basic to all valving arrangements is the time-proven Bellows four-way directional slide valve with its integral controls for regulation of piston rod speed. Basic, too, is the single air connection which may be flexible hose, and which does away with multiple piping. It is in the methods used to shift the directional slide valve that this new flexibility in air control becomes so apparent.

All Bellows Air Motors, with any integral valve control, are available in five bore sizes: 1¼", 1¾", 2½", 3⅜" and 4½" and in stroke lengths up to 48". A wide range of mounting styles further adds to the flexibility of this compact, self-contained power unit.

This new 20 page, four color booklet tells the complete story. It is free on request. Ask your local Bellows Field Engineer for a copy, or write direct to Dep't AH-256 The Bellows Co., Akron 9, Ohio. Ask for Bulletin BM-28.

The Bellows Co.

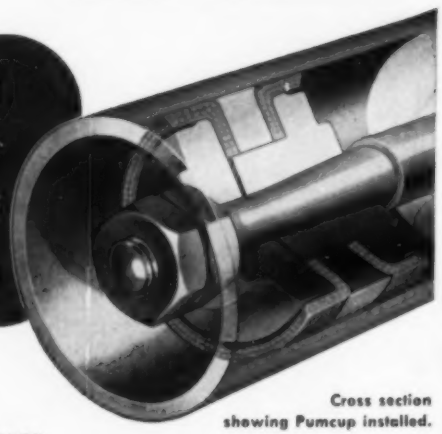
AKRON 9, OHIO

Bellows "Controlled-Air-Power" for Faster, Safer, Better Production

632A

PRESSURE UP! COSTS DOWN!

Slippage Reduced
in PUMPS
AIR CYLINDERS and
HYDRAULIC CYLINDERS
with
DARCOVA PUMCUPS



Cross section showing Pumcup installed.

NORMAL wear of ordinary packing reduces efficiency to a tremendous degree.

In contrast, Darcova Pumcups actually retain their efficiency . . . and they outlast most other packings at least 3 to 1!

Their scientific construction makes it possible to reach *and hold* peak efficiency. Under pressure Pumcups hug the cylinder walls to provide a uniform seal and exert full pressure where it is needed. This means reduced slippage, lower power costs and far less maintenance.

Write for helpful data-and-proof bulletins: No. 4502 on Pumcups for air and hydraulic mechanisms; No. 4401 on Pumcups for reciprocating pumps.

Cost-minded engineers in many industries have standardized on Pumcups to solve their packing problems. The list of successful applications includes the following installations:

- Die casting machines
- Forming and drawing presses
- Straightening presses
- Pipe bending machines
- Briquetting machines
- Pusher mechanisms
- Door control devices
- Lifting and dumping devices
- Spraying equipment
- Proportioning pump regulators
- Recoil cylinders
- Air booster pumps
- Grease guns
- Automatic bottling and filling machines
- Extrusion presses
- Steering mechanisms

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THE ORIGINAL COMPOSITION CUP

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT 15, PA.

PUMCUPS

BRIEFS continued

Giant Cylinder

For use on a metal stretching machine, Oilgear Company designed and built this 3000 psi heavy duty cylinder. The unit has an 11¼ inch bore, 84 inch stroke and weighs 5895 pounds. During stretching operation the cylinder

exerts up to 250,000 pounds pushing force at any speed up to 118 ipm, during return a pulling force up to 110,000 pounds is exerted at any speed up to 243 ipm.

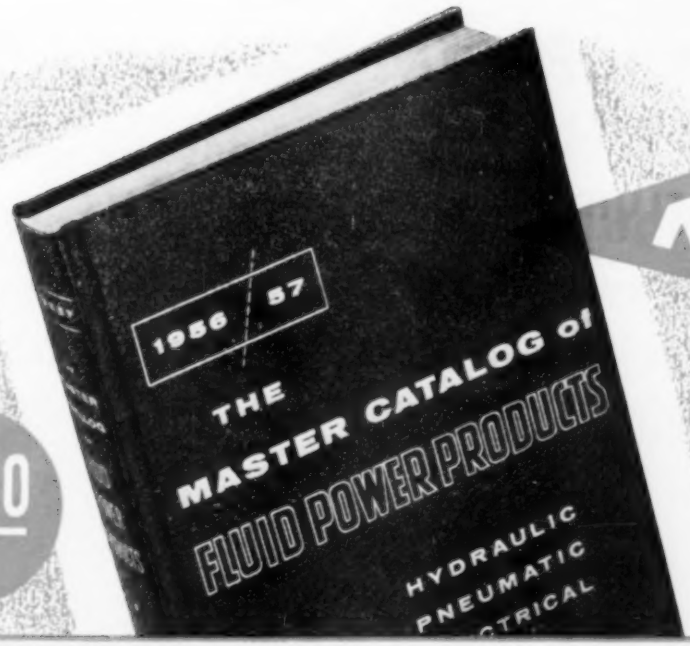
Oil for operating this cylinder is supplied by a 45 gpm two-way variable delivery radial piston pump with hydraulic-servo motor lever control. Pump is driven by a 50 hp electric motor. ▼▼▼

Servomechanisms— As Applied To Large Machinery

. . . was the subject of a paper given by James Robinson, chief engineer, Vickers, Inc., before a recent meeting of the Hydraulic Section, ASME Philadelphia Chapter.

In introducing his talk, Robinson reviewed briefly the pioneer work of Dr. Hele-Shaw on the variable delivery radial piston pump and the work of Williams and Janney on the "tilt box" axial piston pump; these units forming

Continued on page 26



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COMPONENTS AND UNITS
ACCUMULATORS—Types, Applications, Selection, Typical Computations for Cylinder Operation
FLUID POWER BOOSTERS—Types, Advantages, Selections
FLUID POWER CYLINDERS—Applications, Mountings, Construction, Cushions, Force Developed, Air Requirements, Ordering Specifications
ELECTRICAL COMPONENTS—Five Design Steps for Control Systems, Electrical Symbols, Selection of Controls, Electric Motor Characteristics, Uses of Limit Switches
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HYDRAULIC FLUIDS—Petroleum Base, Properties and Characteristics, Fire Resistant, Aqueous and Non-Aqueous Base
PACKINGS AND SEALS—Types of Mechanical Seals, J.I.C. Recommended Practices (Specifications), Backup and Wiper Rings
PUMPS—Gear Types, Vane, Piston, Reciprocating
TUBING, PIPING, MANIFOLDS—Tables of Size, Tubing Specifications, Recommended Working Pressures, Wall Thickness of Tubing, Types of Panel (Manifold) Construction
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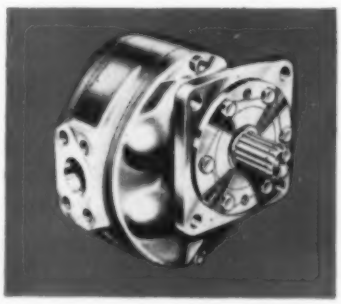

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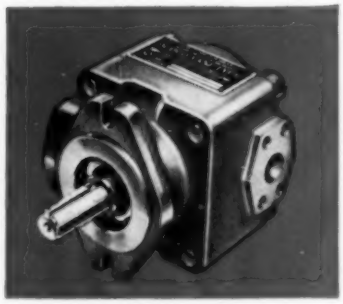

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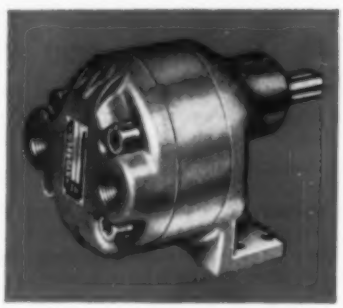

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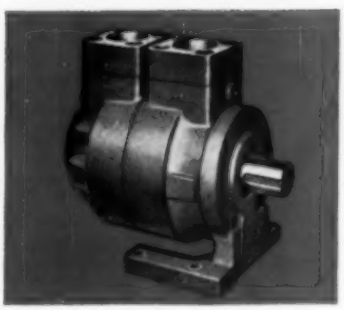

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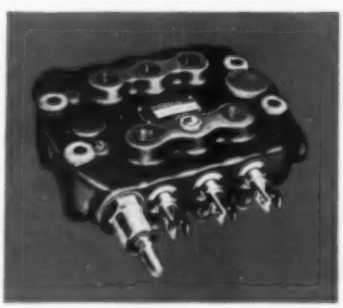

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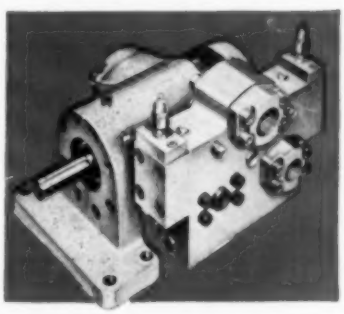

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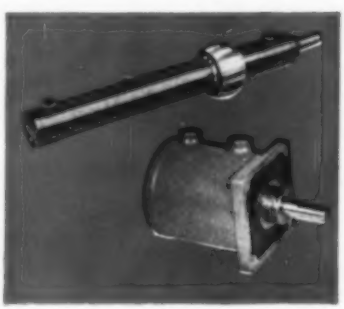

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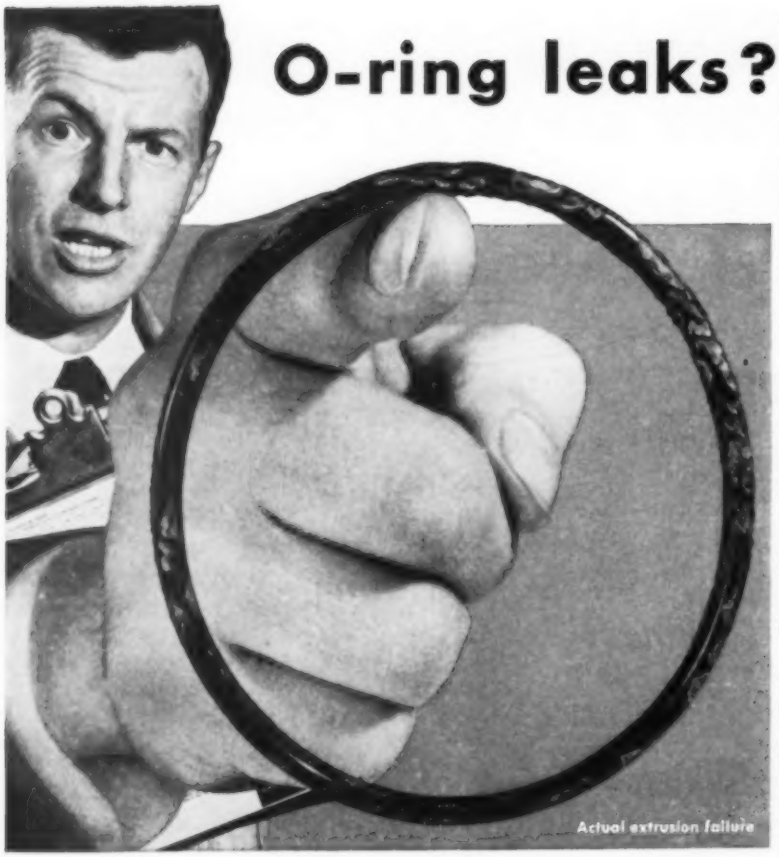

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Parker
Hydraulic and fluid system components

BRIEFS / continued

the basic design of practically all the hydraulic power units now used on large servo systems.

Discussing industrial applications, the speaker highlighted the hydraulic system on the world's largest tube reducing machine built by the E. W. Bliss Co. for the Tube Reducing Corporation. This system incorporates two of the largest variable delivery positive displacement pumps ever built —2300 gpm at 3000 psi—and a very fast cycle that required the pumps to be stroked from neutral or zero delivery position to 2300 gpm in less than ½ second, return to zero delivery during the deceleration part of the cycle, also less than ½ second, reverse flow to same maximum in another ½ second and then return to neutral in less than ½ second.

Taking advantage of the opportunity in addressing leading engineers of the greater Philadelphia area, Robinson made a plea for the better utilization of engineer manpower. He quoted estimates from the Engineering Manpower Commission of the Engineers Joint Council that while 21,000 engineers were graduated in 1955, industry could absorb 37,000. ▼▼▼

Recent Publications

Hydraulic and Pneumatic Power for Production, by Harry L. Stewart; published by The Industrial Press; price $8.50.

Here's the first published textbook covering modern applications for air and oil components. Since Walter Ernst's book "Oil Hydraulic Power and Its Industrial Applications" was published in 1949, Harry Stewart is the only American author who has completed the job of writing a book for this field. This new book deals more with circuits and applications than with component design and theory. It will be of great value to the user of fluid power equipment and to the machine designer who must devise circuits by using commercial components.

The twenty-one chapters include discussions on fluids, power units,

Continued on page 28

SECO hydraulic VALVES IN STOCK

Simplex Engineering has had many years of experience in designing hydraulic circuits, and in building all types of hydraulic power and control systems. We have always used the most suitable components obtainable for each application – regardless of who the manufacturer might be. This we still do. Hence we well realize that there are many good *valves* of every type. We have, however, designed numerous valves for our own use – where there was evident a real need for lower cost, or greater simplicity, or the ability to perform at higher pressures. These valves we manufacture in quantity, *and carry in stock*. They are for sale "off the shelf".

SAFETY RELIEF VALVES

For limiting operating pressures. Six models—500 to 10,000 PSI—each adjustable within limits. Chatterless. Relief set by adjusting screw. Hooded, and provided with lock and key.

HIGH PRESSURE CHECK VALVES

Simple ball check passes flow in one direction only. Designed for pressures up to 10,000 PSI.

HANDWHEEL SET RELIEF VALVES

Ideal where quick and frequent adjustment of pressure is required. Three models — 1,000 to 6,000 PSI.

UNLOADING VALVES (Not Illustrated)

Designed to insure high pressure pump unloading at all times except at the interval when pressure is needed.

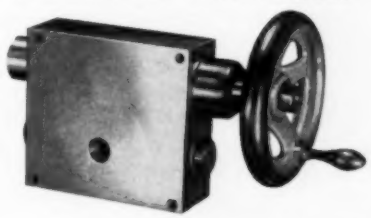
PILOT OPERATED CHECK VALVES

Basically a check valve, but allows free reverse flow when pilot pressure is applied. Seven models cover flow range of 6 to 100 GPM. Max. operating pressure 6,000 PSI.

PILOT OPERATED BLOCKING VALVES

Similar to valve described above except that pilot section is externally drained. For use where back pressure occurs in the inlet line. Models cover same range as Pilot Operated Check Valves.

HIGH PRESSURE 4-WAY VALVES



For manual control of many simple hydraulic circuits involving double-acting cylinders. Permits fine graduation of pressure and volume. Body is forged steel. Pressures up to 10,000 PSI.

If you use hydraulic valves you should have the SECO Catalog. Use the reader's service card.

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Circle 82 on Reader Service Card

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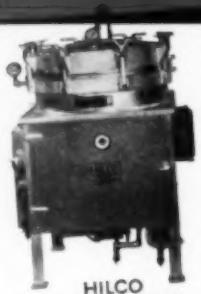
Filter life up to a year eliminates usual frequent draining, refilling of systems.

HILCO Hyflow Oil Filters trap dirt, acids, rust, sludge, gums, resins . . . all solid contaminants, and keeps your hydraulic system clean and in top running condition at all times. To you, this means longer oil life, reduced wear and abrasion . . . hence, less down time and lower maintenance costs giving you continuous equipment operation with increased production. Hydraulic unit sensitivity depends upon a clean system. HILCO Hyflow filters remove solids as soon as they enter the system and retain much of the moisture which enters the oil from the atmosphere and from condensation. Obtain the full capacity and economy of your equipment by keeping it in top running condition with HILCO. Hydraulic Oil Filters come in stationary or portable models. They can be hooked into hydraulic systems without interrupting equipment operation.



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IN CANADA:

BRIEFS continued

accumulators, system plumbing, valves, cylinders, motors, heat exchangers, packings, and filters. Articles concerning circuit problems which have been authored by Mr. Stewart and published in various technical magazines during recent years have been included in the book. They include: synchronizing circuits, dual pressure hydraulic systems, safety controls, sequencing circuits and air-oil circuits. All circuits in the book are drawn with JIC symbols. ▼▼▼

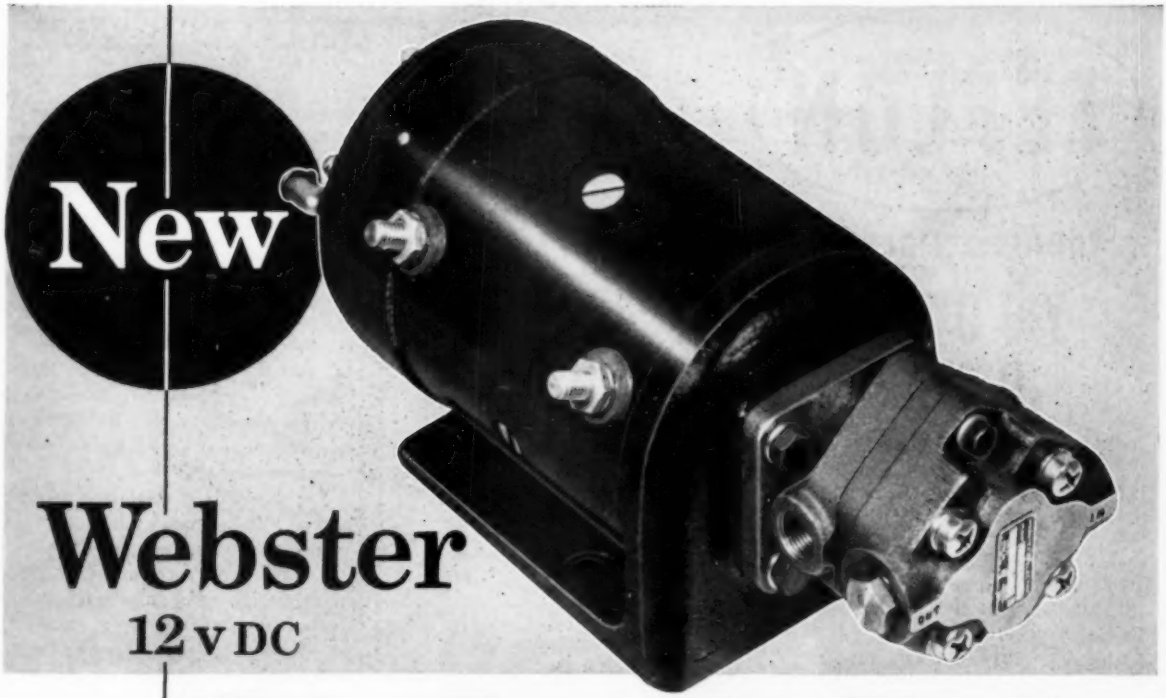
Hydraulics In Machine Tools . . .

. . . is the title of a paper to be given by Albert H. Dall, at the April 10 meeting of the Fluid Power Systems Divisions Philadelphia Section ASME.

Albert H. Dall

Dall, director, Standard Machine Tool Engineering, Cincinnati Milling Machine Company, has a unique background in the machine tool field. After leaving grade school he worked in various machine shops as a machinist helper, blueprint boy and draftsman. Before studying for an ME degree in 1925, he attended evening classes of The Ohio Mechanics Institute and University of Cincinnati. His half time employment during those years were spent at Cincinnati Milling Machine Company, with which he has been ever since. From 1931 to 1951 he worked as a research engineer, and since 1951 has been in the engineering design department. Among the research projects on which he has

Continued on page 30



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Adaptable · Pumps with greater or smaller capacities can be substituted without changing the mounting. Parts are standardized and interchangeable for greatest flexibility. Built-in relief valves and check valves can be provided if desired.

Nylon Valves—a Webster Exclusive · Nylon check and relief valves, exclusive with WEBSTER, for leakproof operation and longer life. Nylon plungers provide tight seal even if minute particles of foreign matter are caught between plunger and seat.

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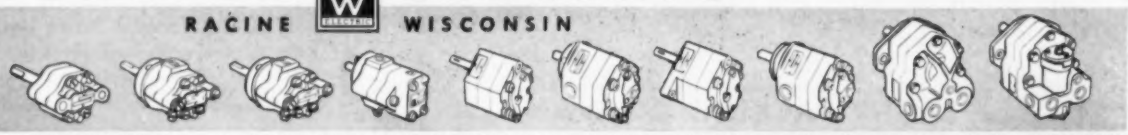

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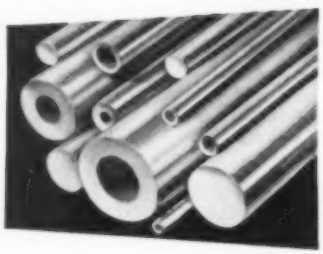

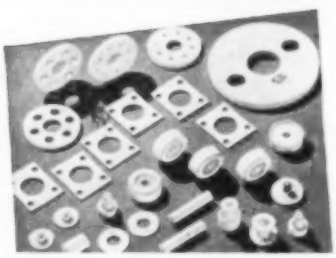

"Made of Teflon by JOHN CRANE" has become practically a standard specification for parts and components subject to severe electrical, corrosive, thermal, mechanical or atmospheric abuse. Whatever your requirements in Teflon . . . sheet, rod, tubing, packings, gaskets, bellows, insulators, sealing discs or non-stick parts . . . "John Crane" can supply them!

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"John Crane's" complete fabrication facilities assure you prompt delivery on *exactly* what you want —no compromise. If you have an entirely new requirement, no standard design or procedure— "John Crane's" laboratory facilities, know how, research and engineering experience go to work on *your particular* need.

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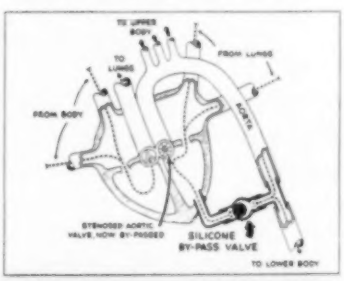
BRIEFS continued

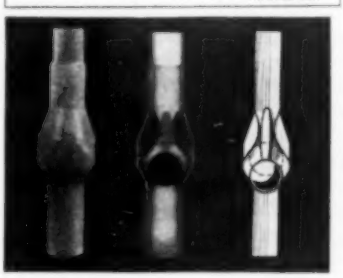
worked are the study of precision grinding, grinder spindle bearings, general lubrication and hydraulics. ▼▼▼

Ball Check Valve For Human Heart

Progress in fluid power is mostly associated with its application in the industrial and aviation fields. Today, however, medicine is experimenting with a fluid power component designed for human maintenance.

The heart is a dual two stage pump, with inlet and outlet valves working in tandem for each beat. To relieve a malfunctioning of the heart's main outlet valve (stenosed aortic valve), frequently caused by rheumatic fever, a substitute valve helps to establish a system which by-passes the crippled valve and forms a new connection from the left ventricle to the aorta.





Top illustration shows location and operation of the by-pass valve. Three views of the valve are shown below. Straight photo of exterior; an X-ray type view showing its translucence and the ball check position; and a line drawing demonstrating how it works.

This valve, developed by a group under Dr. Stanley J. Sarnoff of the National Heart Institute, is a simple ball check unit made up of a molded silastic case and an acrylic plastic ball. Resil-

Continued on page 32

WHAT	WHERE	WHY
SUNVIS 900	**In tight systems** where oil is rarely changed and little or no make-up is needed.	**Exceptionally long life** of oil keeps overall costs low.
SOLNUS	**In tight systems** where make-up oil is less than 5% per month.	**Moderately priced** ... excellent stability and rust protection.
SUNTAC	**In leaky systems** where make-up average is 5% or over per month.	**Reduced leakage** in systems cuts oil costs and downtime.
CIRCO	**In systems** where oil is continuously diluted by water, cutting fluids and other contaminants.	**Low-priced** ... excellent protection where oil must be changed frequently.
SUNVIS H.D. 700	**In systems contaminated** by dust and deposits of sludge, varnish, etc.	**Cleansing action** removes deposits and eliminates costly teardowns.
LUBEWAY	**In dual purpose systems** of machine tools where hydraulic oil is also a way lubricant.	**Added film strength** of this hydraulic oil also eliminates "stick-slip" on ways.

CHART SHOWS WHERE AND WHY SUN HYDRAULIC OILS SAVE MONEY

As the chart shows, to operate your hydraulic system at maximum efficiency and minimum cost you must consider the condition of your hydraulic system, as well as pressures, operating temperatures and other usual factors.

And, very important, you must consider the age of your system. Continued use of original oil recommendations can be costly. A change in the type of oil can often result in substantial savings...especially where systems have developed leaks or where sludge and varnish cause excessive maintenance.

For complete information about how Sun hydraulic oils can help you cut operating costs of your hydraulic system, see your Sun representative... or write SUN OIL COMPANY, Philadelphia 3, Pa. Dept. AH-2.

SUNOCO

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY PHILADELPHIA 3, PA.

IN CANADA: SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

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★ DESIGNED FOR EVERY PISTON AND ROD ★ ROCK-HARD RINGS ★ POLYMER SATURATED FABRIC ★ PRECISION TRIMMING ★ PROPER INTERFERENCE FOR AUTOMATIC SEALING

Why you always get better sealing with R/M VEE-FLEX

Raybestos-Manhattan combines top-flight design engineering with superior molding techniques. The result is an outstanding packing—in this case America's most copied packing. Whatever your hydraulic application, you can count on getting perfect performance from this self-sealing, self-adjusting packing—even at pressures in excess of 6000 psi. A fine seal results even when the equipment is motionless.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS

R/M's line of molded hydraulic and pneumatic packings includes:

VEE-FLEX PACKINGS
VEE-SQUARE PACKINGS
HOMOGENEOUS VEE-RINGS
FABRIC PISTON CUPS

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R/M **PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Bowling Balls

BRIEFS / continued

ience of the elastic silicone valve permits it to take up some of the impact when the valve closes.

Experimental models have been made in Dow Corning laboratories, molded over glass or mirror-smooth alloy steel mandrels for maximum resistance to clot formation. Due to flexibility of the entrance tubing the ball can easily be forced into place after molding. ▼▼▼

ASME Appoints Fluid Power Systems Subcommittee

A Subcommittee of the Hydraulic Division of the American Society of Mechanical Engineers has been established. Known as the Fluid Power Systems Subcommittee, it consists of the following members: O. S. Carliss, director of engineering, Yale & Towne Mfg. Co.; A. Wilson Laird, vice president, New York Air Brake Co.;

J. S. Bennett

James Robinson

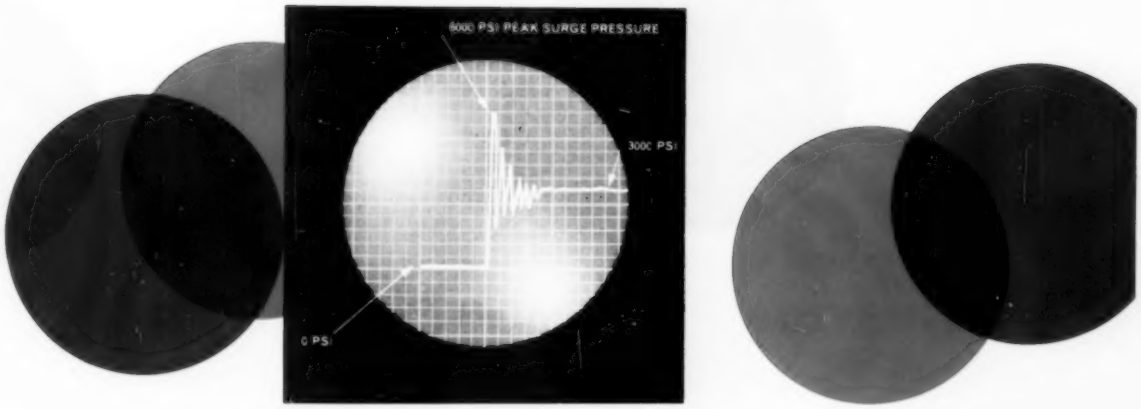
J. Russell Hemeon

O. S. Carliss

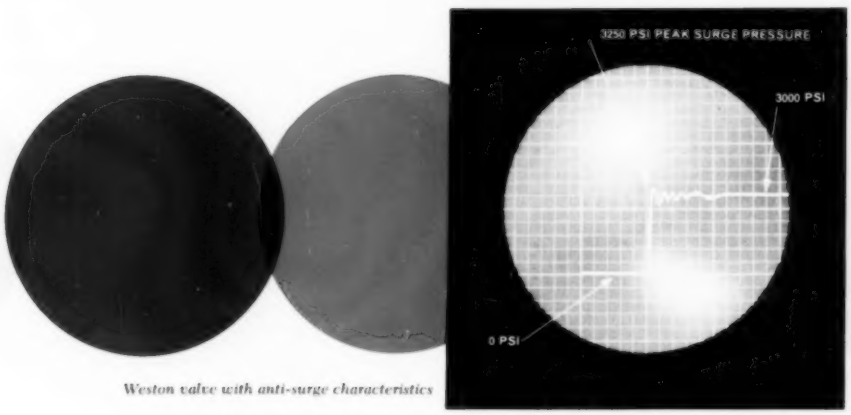
James Robinson; chief engineer, Vickers, Inc.; J. Russell Hemeon, Hydraulic equipment engineer, Ternstedt Div. General Motors Corp.; and J. S. Bennett, vice president, American Engineering Co.

This subcommittee was requested to arrange for two papers to be given at a session at the Cleveland meeting, June 17-21. Another session by the Fluid Power Systems will be arranged for the Annual meeting to be held in New York. ▼▼▼

Continued on page 35



Normal solenoid operated selector valve



Weston valve with anti-surge characteristics

CONTROL OF PRESSURE SURGE SHUDDER IN HYDRAULIC SYSTEMS

...WITH WESTON ANTI-SURGE VALVES

Pressure surges are normally the worst enemies of hydraulic systems. Specifications now limit surge pressures to 135% of the normal system pressure, but in many installations it has been difficult to achieve this limitation.

The solution to this problem is now being produced by Weston Hydraulics, whose designers have designed anti-surge characteristics into the pilot-operated 3-way and 4-way solenoid valves. This modification can be incorporated at no increase in weight and only a slight increase in cost. If you have pressure surge problems, our engineers will be happy to recommend the best configuration to meet your needs.

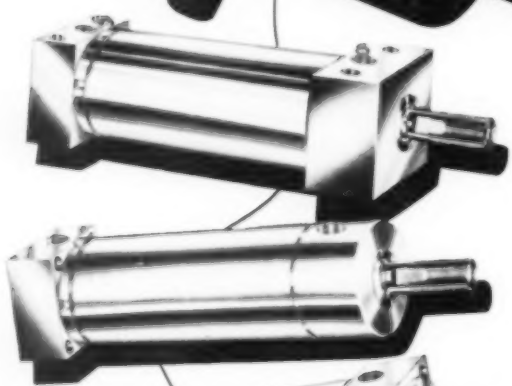
Available in a variety of body styles as illustrated, and in port sizes from one-quarter to one inch.

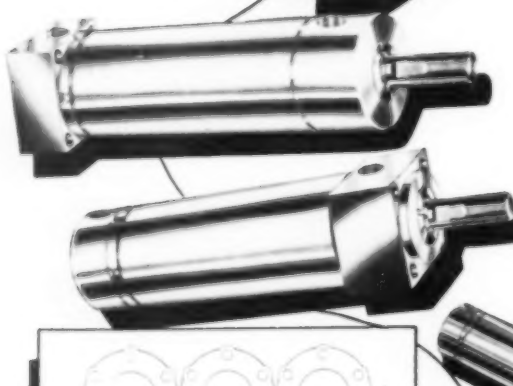
BW weston HYDRAULICS, LIMITED 10918 BURBANK BOULEVARD, NORTH HOLLYWOOD, CALIFORNIA

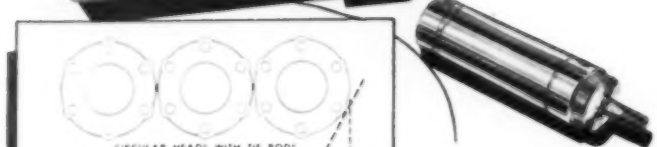
a Subsidiary of the Borg-Warner Corporation

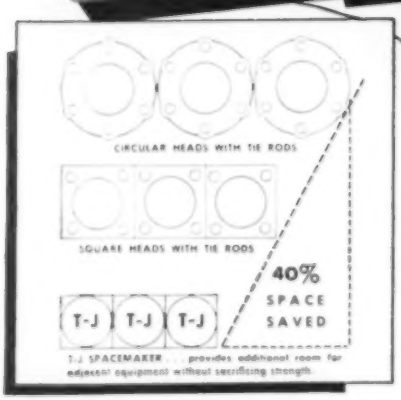
DELIVERY OFF THE SHELF©

IN 64,000 COMBINATIONS








CIRCULAR HEADS WITH TIE RODS
SQUARE HEADS WITH TIE RODS
40% SPACE SAVED
T-J
T-J
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T-J SPACEMAKER . . . provides additional room for adjacent equipment without sacrificing strength.

T-J

Spacemaker CYLINDERS

OUTMODE ALL OTHERS . . . SAVE 40% SPACE!

You'll never go back to tie-rod cylinders, once you apply T-J Spacemakers to your push-pull-lift jobs! Advantages in space saved, weight saved, greater strength and off-the-shelf delivery are among the dozens of Extras you get as Standard!

Now — these sensationally popular T-J Spacemaker Cylinders are available off the shelf *in sizes up to 8"*. This means as many as 64,000 different combinations of styles, bores, strokes, mountings, etc. *immediately available!* Oil pressure to 750—Air to 200 P.S.I. Super Cushion Flexible Seals for Air . . . New Self-Aligning Master Oil Cushion. Hard chrome plated bodies and piston rods (Standard). Only from T-J can you get these new ingenious cushion designs! Send for bulletin SM-155-2. The Tomkins-Johnson Co., Jackson, Mich.

See us in Fluid Power Area ASTE Show Booth 225

Member of the National Fluid Power Association

T-J **TOMKINS-JOHNSON**

RIVITORS...AIR AND HYDRAULIC CYLINDERS...CUTTERS CLINCHORS

Circle 93 on Reader Service Card

BRIEFS / continued

FUTURE EVENTS

February 27-March 2: American Society for Testing Materials. National Meeting. Hotel Statler, Buffalo, New York.

March 14-16: 1956 Aviation Division Conference of the American Society of Mechanical Engineers. Beverly-Hilton Hotel, Los Angeles, California.

March 19-23: 1956 ASTE Industrial Exposition. International Amphitheatre, Chicago, Illinois. "Tooling for Tomorrow" will be the theme of the exposition, which will be held in conjunction with the Society's 24th annual convention.

April 10-12: 12th Annual Meeting of the Metal Powder Association and the 1956 Metal Powder Show. Hotel Cleveland, Cleveland, Ohio.

April 30-May 4: SAE Aircraft Committee Meetings—A-3, A-6C, A-6—to be held at the Conrad Hilton Hotel, Chicago, Illinois.

May 14-17: First Design Engineering Show. Convention Hall, Philadelphia, Pa. Machine Design Division of ASME will sponsor design engineering conference to coincide with exposition.

May 27-31: 1956 Spring Meeting, National Fluid Power Association. The Greenbrier, White Sulphur Springs, West Virginia.

June 5-8: The Material Handling Institute's Exposition of 1956. Public Auditorium, Cleveland, Ohio.

September 17-21: The Instrument Society of America, the 11th Annual Instrument-Automation Conference and Exhibit. New York Coliseum, New York.

October 18-19: 12th National Conference on Industrial Hydraulics. Sherman Hotel, Chicago, Illinois. Conference Secretary is Raymond D. Meade.

October 30-November 1: 1956 Fall Meeting, National Fluid Power Association. Hotel Cleveland, Cleveland, Ohio. ▼▼▼

we work with Fluorocarbons ...and "know-how"

Electronics Test Cage

Physical Testing Laboratory

Injection Molding

Fluorocarbon Machining

The United States Gasket Company is the recognized leader in the fabrication and application of the "Wonder Plastics", duPont TEFLON, Kellogg KEL-F and BAKELITE Fluorothene—leadership earned through many years of pioneering.

Today, this company offers engineering and manufacturing talent and facilities unmatched in the industry to assist its customers in the profitable application of Fluorocarbon Products for almost countless purposes.

To render this service, three highly specialized laboratories are maintained—electronic, chemical and physical—staffed by engineers who continue to produce most of the advanced ideas and practices in the application of these plastics to commercial, A.E.C. and military requirements.

Manufacture is Quality Controlled, utilizing the most modern facilities for rapid, low cost production. Many machines and equipment have been designed or converted by our own engineering department to the peculiar requirements of Fluorocarbon Plastic Fabrication.

• Write for the twenty-page brochure "Inside U. S. G." that suggests how this organization can fit into your development and production program.

U S G BELMONT

UNITED STATES GASKET CO.

CAMDEN 1, NEW JERSEY

Guarantee TOP Performance and Maximum Life!

Specify THESE TOP QUALITY FEATURES...

(Standard on Miller Cylinders at no extra cost)

Specify CASE HARDENED CHROME PLATED PISTON RODS
On all Air and Hydraulic Cylinders

Benefits To You

CASE-HARDENED Piston Rods (52-54 Rockwell "C") provide practically complete protection against damage from hammer blows, wrench-dropping, mishandling, and similar occurrences. ***Available from Miller at no extra cost.***

The HARD CHROME PLATING over the case-hardened rods protects against scratch-damage and rust. ***Available from Miller at no extra cost.***

Specify "TEFLON" WIPERS
On all Air and Hydraulic Cylinders

Benefits To You

"TEFLON" Rod Wipers and "TEFLON" Hydraulic Piston Rod Seals withstand temperatures from—100°F. to plus 500°F. They are impervious to practically all known chemicals, including the fire-resistant, special, and standard hydraulic fluids in current use. ***Available from Miller at no extra cost.***

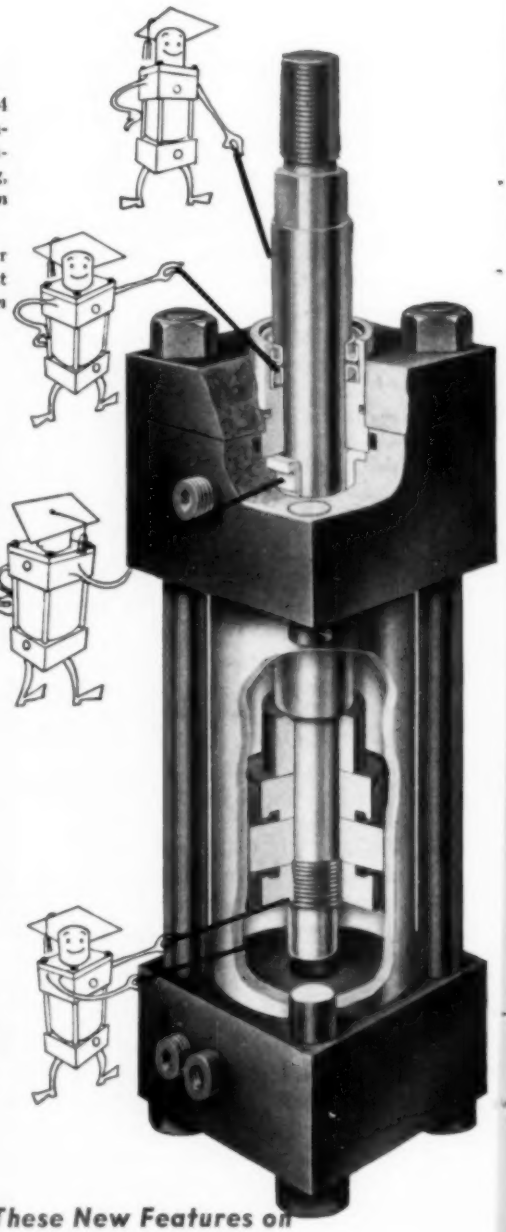
Specify TEFLON HYDRAULIC ROD SEALS
On all Hydraulic Cylinders

Specify RUST RESISTANT SURFACES
On all Air and Hydraulic Cylinders

Benefits To You

Highest quality Black Ferric Oxide Finish provides rust protection in air cylinder operation and on all cylinders during shipping and installation.

Cylinder heads, caps, mountings, pistons, followers, tie rods, and the unplated portions of the piston rods have this finish ***at no extra cost on all Miller cylinders.*** (This finish not recommended for water service)



You may wish to route this entire page to the proper department in your company, by using this handy form. Additional copies on request. →

To (Dept.) _____

"On all our future cylinder requirements, please specify the above quality features."

Signed _____

Title _____

See These New Features on Miller Cylinders at Miller

BOOTH # 429

A. S. T. E. SHOW, March 19-23
International Amphitheatre, Chicago

SALES AND SERVICE FROM COAST TO COAST

CLEVELAND • YOUNGSTOWN • DAYTON • TOLEDO • CINCINNATI • COLUMBUS
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TORONTO, CANADA and OTHER AREAS

MILLER FLUID POWER CO.

Miller = **2008 N. Hawthorne Ave. Melrose Park, Ill.**

AIR & HYDRAULIC CYLINDERS • BOOSTERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS

In 1945-46 You Benefited . . .

From the following quality cylinder "Firsts" offered by Miller Fluid Power Company on its standard catalogued power cylinders:

☐ 1. Square bar steel heads, caps, and components
☐ 2. Welded fabricated steel mountings
☐ 3. Detachable, interchangeable steel mountings
☐ 4. High tensile steel tie rods (4 per cylinder)
☐ 5. High tensile steel piston rods
☐ 6. Chrome Plated Piston rods
☐ 7. Wrench flats on piston rods
☐ 8. Non-corrosive tubing on large bore air cylinders
☐ 9. Step-cut piston rings on hydraulic cylinders
☐ 10. Dirt wipers on air cylinders
☐ 11. Dirt wipers and oil wipers on hydraulic cylinders
☐ 12. Non-adjustable, bubble-tight, leakproof piston rod seals on air cylinders
☐ 13. Non-adjustable, bubble-tight, leakproof piston seals on air cylinders
☐ 14. Non-adjustable, leakproof, hydraulic piston rod seals guaranteed not to leak even one drop of oil
☐ 15. Non-adjustable, leakproof, hydraulic piston seals guaranteed not to leak even one drop of oil
☐ 16. 98% plus operating efficiency on air cylinders of 4" and larger bores at 80 psi
☐ 17. 98% plus operating efficiency on hydraulic cylinders of 4" and larger bores at 130 psi
☐ 18. 1 psi no-load break loose pressure on air cylinders of 3¼" bore and larger
☐ 19. 3 psi no-load break-loose pressure on hydraulic cylinders of 4" bore and larger
☐ 20. Seal life in excess of several hundred million feet of piston rod travel on all of the above-mentioned piston seals
☐ 21. Precision-seal cylinders
☐ 22. Seals that seal with pressure on all hydraulic static seals
☐ 23. Catalogued line of hydraulic cylinders of 2000 to 3000 psi operating pressure

In 1954 You Benefited again—from Miller's . . .

☐ 24. Sizable stock cylinder program
☐ 25. Model 77 heavy duty detachable foot mountings

In 1955 You Benefited again—from Miller's . . .

☐ 26. Greatly expanded stock cylinder program
☐ 27. Case-hardened, chrome plated piston rods
☐ 28. "Teflon" hydraulic piston rod seals
☐ 29. "Teflon" dirt wipers on air cylinders
☐ 30. "Teflon" dirt and oil wipers on hydraulic cylinders
☐ 31. High quality rust preventive finish on all parts not otherwise protected from rust on both air and hydraulic cylinders

Enter in boxes above the YEAR in which your supplier first (if at all) gave you these benefits.

In 1956, You Will Benefit Again . . .

Watch For MORE Miller Firsts!

Useful Literature

For your free copy of publications reviewed, fill in the reader service card

AIR CYLINDERS . . . for heavy duty applications are specified in a new catalog from Petch Manufacturing Co. The cylinders which are designed to JIC Standards have completely interchangeable mountings ,oversize piston rods, floating cushions, and interchangeable cushion screw and ball check assembly. One page of the catalog is devoted to charts showing piston area, cylinder force, and volume of air required for cylinders from 1½ to 8-inch bore. The rest of the catalog presents dimensional data and parts for cylinders in this size range.

Circle 155 on Reader Service Card

PUMP-MOTORS . . . manufactured by Geo. D. Roper Corp. are the subject of a news-letter from the company. Citing some of the numerous applications of pump-motors such as powering mixers, reels, and conveyors, the letter also states the advantages of fluid power with these units. Flexibility of control, safety, ease of installation are particular advantages. An estimated delivery schedule is presented in the news-letter and a list of approximately 175 dealers is given.

Circle 156 on Reader Service Card

FLEXIBLE METAL HOSE . . . used to compensate for misalignment, eliminate vibration, and dampen noise is specified in Catalog 152 from Flexonics Corp. In addition to complete data on the various types of corrugated hose and associated fittings, a page of the catalog is devoted to the selection of flexible metal hose. The procedure is presented in four steps including 1. Type selection 2. Metal selection 3. Hose selection 4. Fitting selection. Graphs are shown for selecting hose from the pressure and ID required.

Circle 157 on Reader Service Card

HYDRAULIC COMPONENTS . . . What are the three purposes of hydraulic horsepower? What parts are needed for hydraulic power? These questions are answered in a 16-page booklet just released by Char-Lynn Co. The booklet is also the manufacturer's catalog showing a complete line of products with performance curves and dimensional drawings of various components. Two pages are devoted exclusively to a series of graphs with instructions how to determine load capacity—the load or force a cylinder can lift or push at a known pressure. Nomographs and examples are also shown for calculating cylinder speed, volume of oil required per cylinder stroke, horsepower, and pump size. The company's line of pumps, reservoirs, valves, and cylinders is illustrated with typical applications.

Circle 158 on Reader Service Card

"MOTORS & DRIVES . . . For the Machine Tool Industry" is the title of an informative brochure just published by The Louis Allis Co. The company has drawn form long experience in building motors for machine tools to present photos and information on many special and standard motors and adjustable speed drives. Comprehensive descriptions provide essential data on more than 15 motors and drives. Installations are illustrated and technical data on electrical features are given.

Circle 159 on Reader Service Card

SERVO VALVE . . . which is particularly well suited for multiple installations where a number of cams are operated on a single cam shaft is introduced in Bulletin CO-5 offered by Hydraulic Controls Co. Valve dimensions are given for the unit which allows a center-to-center mounting distance of 2 inches. All hydraulic connections are taken from the top of the valve. Positional feedback can be obtained either by linkages or by mounting the valves directly on the cylinder. The 4-way valve can be used as a 3-way valve by blocking one port. The valve spool is spring loaded and the chamber is drained to tank to eliminate the effects of exhaust oil back-pressure on the end of the spool.

Circle 160 on Reader Service Card

ACCUMULATORS . . . of the floating piston type with double shell construction are specified in a catalog issued by Superior Hydraulics. A cutaway photograph of each unit is included with general design notes such as pressures and seals, dimensions, and part numbers. Also given with each type is a chart of maximum oil volume at indicated operating pressures with various precharge pressures. Drawings for various accumulator charging and gage assemblies are also included in the catalog.

Circle 161 on Reader Service Card

For more reviews of FREE LITERATURE turn to page 100

★Snap-Tite

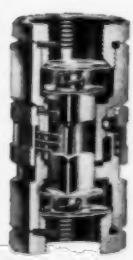
QUICK-CONNECT
QUICK-DISCONNECT COUPLINGS

in larger sizes

immediate delivery
FROM FACTORY STOCKS

SNAP-TITE'S "H" COUPLING; SIZE FOR SIZE, IS THE SMALLEST COUPLING WITH HIGHEST STRENGTH AND HIGHER EFFICIENCY

Snap-Tite's "H" Couplings are now factory-stocked for quick shipment to you, not only in the smaller sizes (below 1" ID) but in all sizes up to and including 3"—in steel, brass, aluminum, and 303 and 316 **Stainless Steel.** And "H" Couplings can be made to your order, up to 10" ID.



Available with valves to give two-way or one-way automatic line shut-off, or without valves for straight-thru flow, "H" Couplings are built to handle high pressures in hydraulic and air systems.

Recessed valve washers . . . fluted valve stems . . . valve stops with minimum flow restrictions . . . large inside diameter—allow maximum flow capacity with lowest pressure drop.

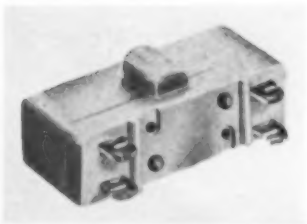
See the Snap-Tite representative in your city or write for Bulletin 240.

★Snap-Tite, INC.
UNION CITY 1, PENNSYLVANIA

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

New Products

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.



MINIATURE SWITCH
. . . handles 40 amps

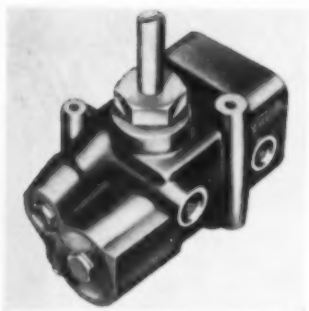
Designation: Model G3-8

Design: Switch combines double break feature of basic switch with heavy duty switching element, and is ideal for installations where size is a problem. Switch case is made with new plastic compound which gives switch higher temperature rating and extreme resistance to shock.

Specifications: Operating force is 30 oz. and electrical and mechanical life is 100,000 cycles. Current rating is 40 amps at 125/250 volts ac or 30 volts dc.

Electro-Snap Switch & Mfg. Co.
Chicago, Illinois

Circle 110 on Reader Service Card



AIRCRAFT STEERING VALVE
. . . in packaged design

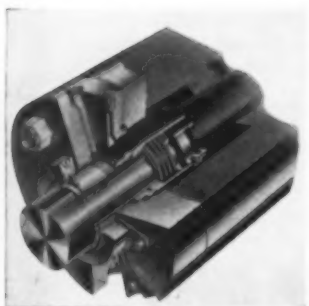
Designation: EA-56101

Application: Rotary input, constant gain steering valve is for nose wheel steering applications requiring automatic castering control. Self-contained control is for systems operating at pressures to 3000 psi and is available for any flow capacity requirements. Metering characteristics can be tailored to the system.

Features: Packaging of all elements into one housing results in weight saving up to 500% and reduces maintenance. Flow through the valve in relation to valve displacement is constant regardless of inlet pressure, load, or back pressure. This "constant gain" ensures that the rate of wheel movement will be a function of valve displacement only. Rotary input design permits installation on the nose wheel strut. Motion of the strut provides follow-up as the wheel is steered, simplifying mechanical linkage in the system. Both static and dynamic steering is provided. Damping is achieved by keeping cylinder lines under pressure. Anti-shimmy characteristics of valve also contribute to steering stability.

Vickers Incorporated
Detroit, Mich.

Circle 111 on Reader Service Card



MECHANICAL SEAL
. . . made of one-piece assembly

Designation: Unitary Type AA51B-23

Features: The entire unit, including sleeve and gland is self-contained. It has a collet type drive. External look and drive are readily accessible. Circulating connections in glands provide cool, clean lubrication. To insure long life all sealing surfaces are precision lapped and all high pressure seals are pressure balanced.

Applications: For use on process pumps, oil refinery pumps and others.

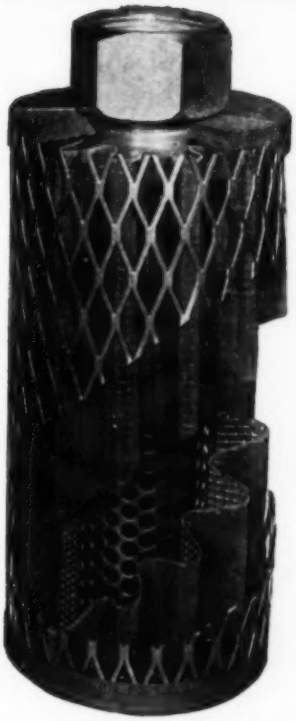
The Garlock Packing Co.
Palmyra, New York

Circle 112 on Reader Service Card

For more NEW PRODUCT reviews turn to page 89

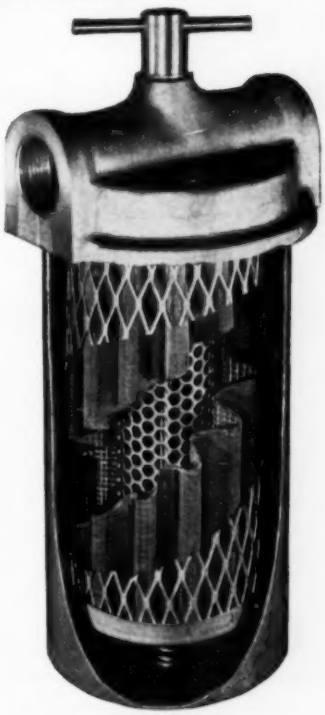
MARVEL Synclinal FILTERS

For Efficient Filtration of—
Hydraulic Oils
Fire Resistant Hydraulic Fluids
Coolants — Lubricants
Water



SUMP TYPE (Cutaway)

OVER 600
Original Equipment Manufacturers Install Marvel Synclinal Filters as Standard Equipment



LINE TYPE (Cutaway)

PROTECT EQUIPMENT
INCREASE PRODUCTION
REDUCE MAINTENANCE

Marvel Synclinal Filters installed in the sump or on the line preceding pump offer maximum protection on all hydraulically actuated and other equipment utilizing low pressure circulating systems. Maintenance and production costs are reduced because Marvel Synclinal Filters BALANCED design offers greater ACTIVE filtering area with sufficient storage capacity for filtered out damaging particles, thus, longer periods of productive operation are attained at minimum "down time" due to maintenance and repairs.

PRODUCTION ENGINEERS and MAINTENANCE MEN whose job it is to keep production machinery operating at peak efficiency and who have recognized the superiority of Marvel Synclinal Filters in the filtration of hydraulic oils, fire resistant hydraulic fluids, coolants, lubricants, etc. are specifying Marvel Synclinal Filters on all new equipment and standardizing with Marvel Synclinal Filters on all machines within their plants.

Another outstanding reason for their preference is the simple construction of Marvel Synclinal Filters which allows them to be easily disassembled, thoroughly cleaned and reassembled on the spot, by any workman in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.

VISIT OUR EXHIBIT BOOTH #1028
TOOL ENGINEERS 1956 INDUSTRIAL EXPOSITION and CONVENTION
International Amphitheatre Chicago, Illinois March 19 thru 23, 1956

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G.P.M. Greater capacities may be attained by multiple installation (as was described in catalog). Choice of Monel mesh sizes range from coarse 30 to fine 200.

IMMEDIATE DELIVERY!

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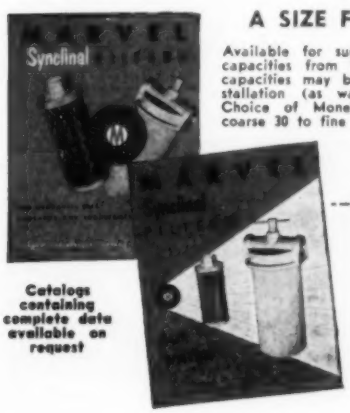

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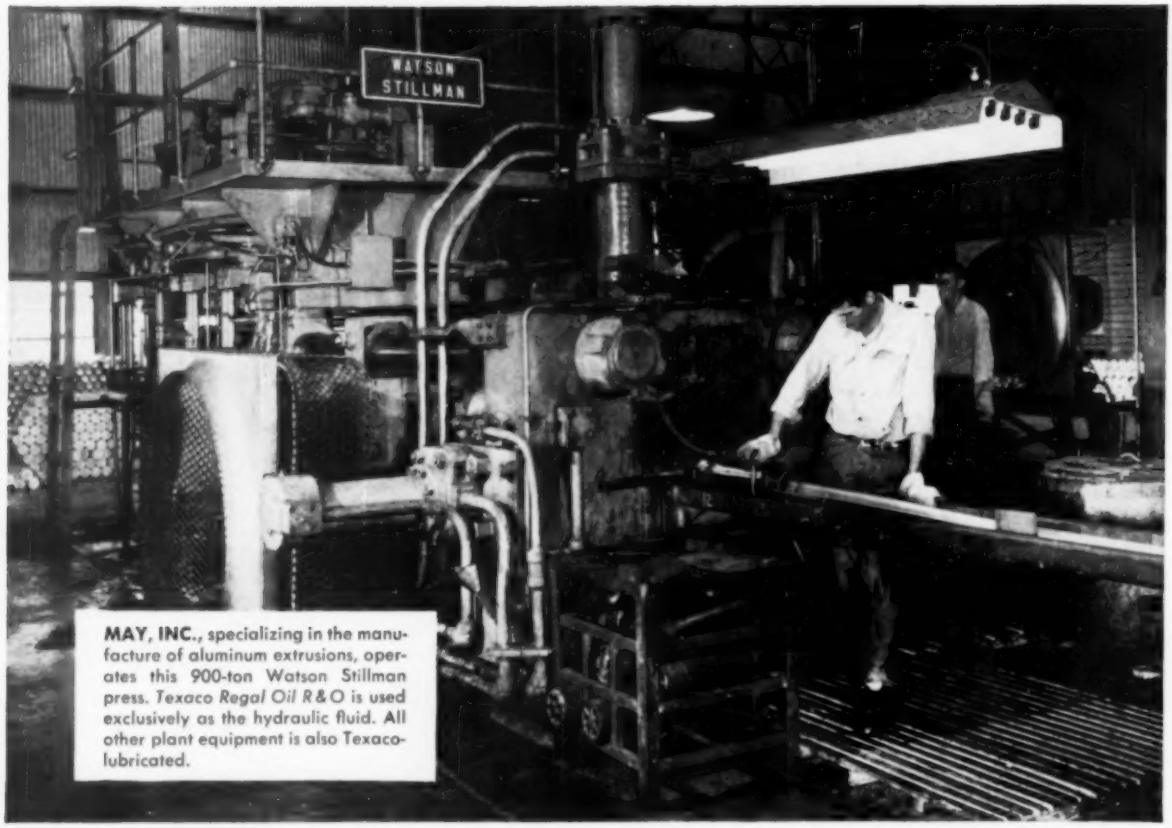

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● By Allan E. Morris
Associate Editor APPLIED HYDRAULICS

ELECTRICAL COMPONENTS

for fluid powered equipment

TODAY the designer is technically limited only by his own ingenuity and his knowledge and experience of the components available to him. The better he understands these components—their capabilities and limitations, the more advanced will be his ability. These components are the "words" in his design "vocabulary". A large "vocabulary" of components and the ability to choose just the right "word" will spell the difference between success and failure of many an engineering project in the competitive future.

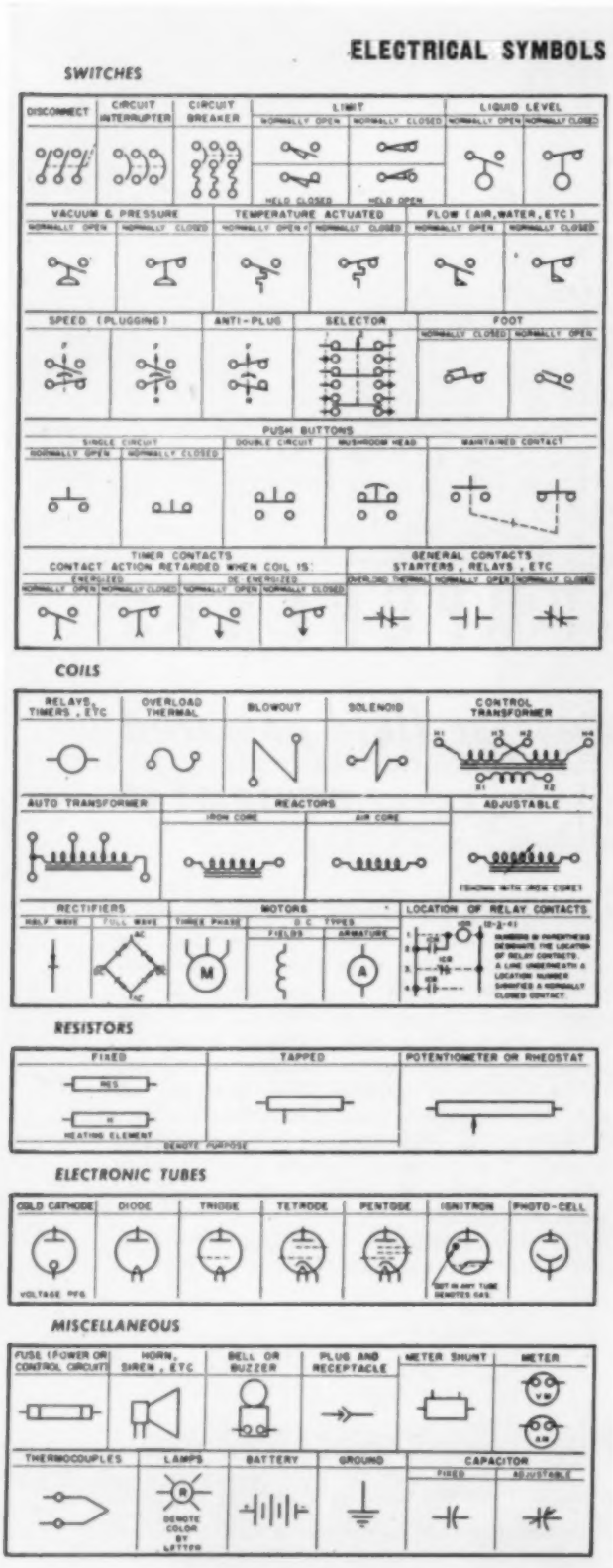
SELECTION OF CONTROLS

Sometimes electrical controls are selected because no other controls will do the job. Sometimes there is a choice between electrical and mechanical, hydraulic, or pneumatic controls. In such a situation it is necessary to consider safety, dependability, flexibility, maintenance, and initial cost. In comparison, electrical controls frequently offer a flexibility and convenience that are unobtainable with other controls. All functions of a multi-purpose machine can be conveniently controlled from one or several positions. Safety of operation on a press, for example, can be easily provided with duplicate controls requiring the operator to use two hands to start the machine. Machine positions are easily monitored by limit switches which can start one phase of machine operation after completion of another. Pressure switches act in the same manner to monitor pressure and to initiate pump unloading or provide protection. Timers are the sequence controls of the machine and regulate the period of each operation. Their speed and variety of arrangements make them a valuable asset to any machine where accurate dwell is required. Solenoids are the muscles of the electrical nerve system and actuate the valves of the hydraulic or pneumatic system.

The electrical components most applicable to control of hydraulic equipment are:

a. Motors
b. Motors Starters
c. Pushbutton and Selector Switches
d. Limit Switches
e. Pressure Switches
f. Timers
g. Relays
h. Solenoids
i. Transformers

In addition to the more common electrical devices for fluid power control, the recently developed ser-



vovalves are finding wider applications in this field. These valves provide infinitely variable flow control and incorporate an electrical device to actuate the valve. The valve opening is proportional to the electrical current. The prospects for this unit are excellent, especially as the controller in hydraulic position servomechanisms. These servovalves can be used to control the feed on machine tools and to control wing and tail surfaces on aircraft.

ELECTRICAL SYMBOLS

In order to establish a common language for electrical diagrams, a set of symbols has been adopted by the Joint Industry Conference. These symbols apply to industrial equipment including metal cutting machines, metal forming machines, and other electrically powered or controlled machines.

Electrical diagrams are of the "ladder type" in which the left side represents the power lead and the right side represents the ground lead. Components are shown connected across these two leads. Components which are actuated and have more than one position such as relays, limit switches, pressure switches, and timers are usually shown in the deactuated or reset position. Contacts of relays are designated the same as the corresponding coil. Thus if the coil is designated as 1-CR, all contacts of the relay are also labeled 1-CR.

ELECTRICAL DESIGN PROCEDURE

In designing the electrical circuit for control of a hydraulically operated machine, the engineer must be thoroughly acquainted with the required hydraulic and mechanical operation of the machine. In many instances he will rely upon these hydraulic and mechanical functions for the actuation of his electrical elements which in turn will actuate the solenoid valves.

The development of the electrical circuit is accomplished in a series of steps corresponding to the phases in the machine sequence. In designing the circuitry to accomplish each succeeding step, the previously designed circuit must be considered and care must be taken not to disturb previous functions. To illustrate this procedure, consider the circuit of Figure 1 diagramming a machine having two cylinders designated as A and B. Cylinder A is mounted horizontally and cylinder B is mounted vertically. It is required that A move to the right from position 1 to position 2 and stop. B must then move up from position 3 to position 4. A then exerts increasing pressure against the work until the desired pressure is reached. A and B then retract together.

The circuit of Figure 2 shows the arrangement necessary to move cylinder A to the right. It is necessary to energize the solenoid through the relay contact so that the solenoid remains energized after the momentary Start switch is released. Anoth-

er contact of the relay locks in to maintain the relay energized. In Figure 3 circuitry has been added to stop cylinder A and extend cylinder B. Relay 2-CR has been added, and it is energized by limit switch 1-LS which is actuated when cylinder A is fully extended. Relay 2-CR de-energizes solenoid X to stop cylinder A and energizes solenoid Z to extend cylinder B. To complete the cycle, the necessary components have been added in Figure 4. When cylinder B is fully extended, limit switch 2-LS is actuated energizing a third relay 3-CR. Relay 3-CR de-energizes relay 2-CR to energize solenoid X and de-energize solenoid Z. This allows cylinder A to exert pressure against the work and stops cylinder B. A pressure switch has been added in series with relay 1-CR so that when the pressures reaches the preset value, the pressure switch opens de-energizing relay 1-CR. De-energizing relay 1-CR then de-energizes solenoid X and energizes solenoids Y and W to return both cylinders. In this circuit limit switch 1-LS must open before limit switch 2-LS. The circuit of Figure 4 represents only the basic operations and would be further modified to incorporate safety and interlocking provisions.

SAFETY

During the design of the electrical circuit and after the completion, the engineer must constantly keep in mind the safety of his arrangement.

The means of starting the cycle is of importance both in the design and installation of the electrical system. Where a clamping action is involved, two switches are often required and are installed so that the operator must actuate both simultaneously ensuring that his hands will not be in the vicinity of the clamping mechanism. The system may also be designed so that the operator must keep the switches manually actuated until the clamping has proceeded to a point where it no longer endangers the operator. In order to ensure against unintentional repetition of the cycle, the design may re-

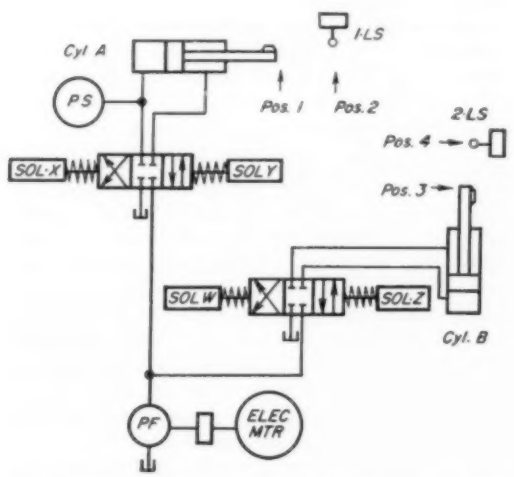


FIG. 1. TWO cylinder machine with sequence controls.

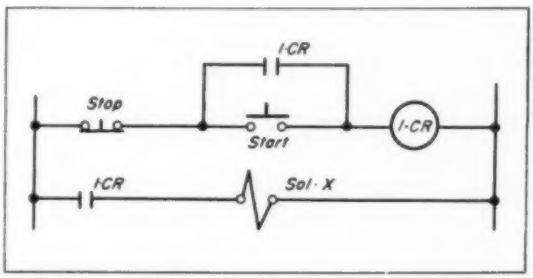


FIG. 2. STEP 1.

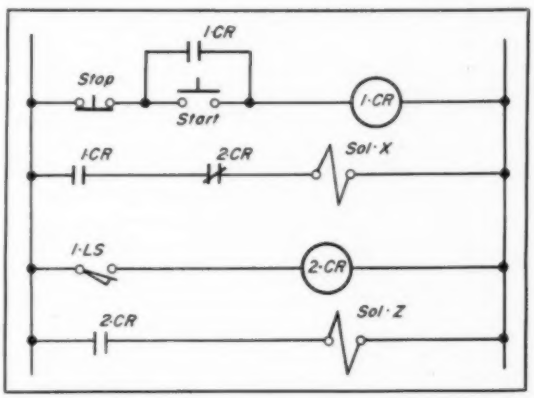


FIG. 3. STEP 2.

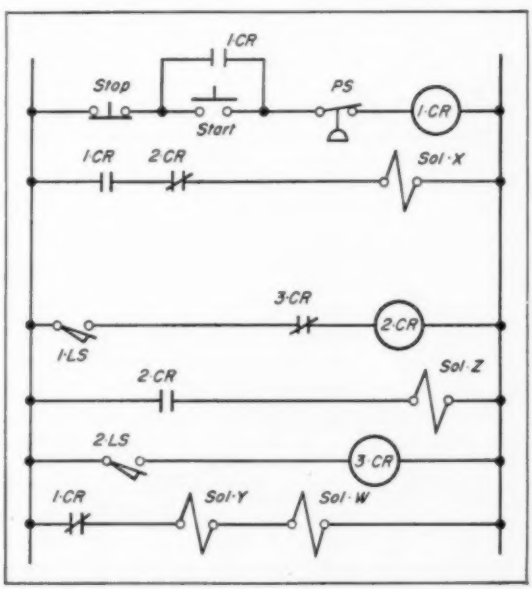


FIG. 4. STEP 3.

quire that the operator release the start switch and re-actuate it before the cycle can be repeated. Emergency means should be provided for stopping or reversing a moving piston.

The possibility that a limit switch or other control device will not operate or will remain actuated must be considered. Often by the proper selection of either the normally-open or normally-closed contacts of the switch, these eventualities can be minimized.

Some machines have auxiliary motors for oil cooling pumps, pilot pressure, etc., and it may be necessary for these motors to be in operation before the main drive motor. To accomplish this, interlock contacts from the auxiliary motor starters can be placed in the main motor circuit. In stopping, it may be required that the auxiliary motors remain running until the main motor stops. This can be accomplished by a timer to delay the stopping of the auxiliary motor.

Electrical circuits should be designed so that motors will not re-start automatically or control become energized if the electrical power returns after a power failure. In a clamping circuit, for instance, a hazard would exist if the clamp would close unexpectedly. In this case, a manually operated, spring-return, two-way valve might be used. In the normal, unoperated position of the valve, clamping pressure is by-passed. When the valve is operated, fluid is allowed to operate the clamp. For normal operation, a limit switch is then actuated to by-pass the manual valve so that the operator may remove his hand from the valve.

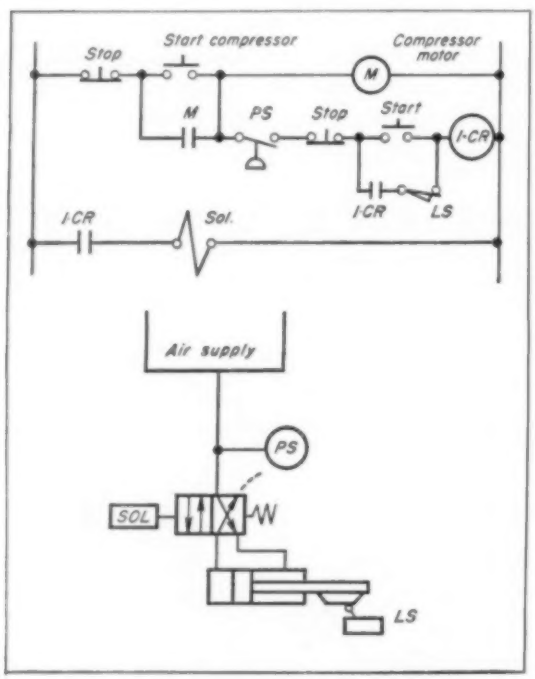


FIG. 5. PNEUMATIC CIRCUIT eliminates a safety hazard.

ELECTRICAL PROTECTION

J.I.C. Standards require certain protective measures in the electrical system. A disconnect switch capable of interrupting the maximum operating overload current must be installed to disconnect all lines of the power circuit. This disconnect should be interlocked with the control box doors, so that power is disconnected when the doors are opened. Undervoltage protection must be provided for all motors which might cause injury or equipment damage if the motor should start on return of power after an interruption.

An example of a design for elimination of a safety hazard is shown in Figure 5. In this circuit of a small air-operated hammer, the pressure switch closes when air is at the required pressure. This permits energizing relay 1-CR with the Start switch through contacts M. Energizing relay 1-CR actuates the solenoid valve directing air to the head end of the cylinder to extend the piston. At the end of the piston stroke, the limit switch is deactuated, de-energizing the solenoid valve and allowing the piston to return. The pressure switch prevents the solenoid valve from being energized when the air supply is off. If the solenoid valve were energized under this condition, when air pressure was restored, the machine would operate without being actuated and would be a safety hazard. The pressure switch eliminates this hazard.

Certain mounting requirements are given in the J.I.C. Standards for protection to electrical control and safety to personnel. The components should be protected from passing vehicles, splashing liquids, or moving objects. The location of the control equipment should not interfere with machine operation, or maintenance. Equipment such as push-button control and limit switches should be rigidly mounted in as clean a location as possible, and these should be protected against accidental actuation. Limit switches should be mounted so that accidental over-travel will not damage them.

ELECTRICAL MAINTENANCE

Maintenance of electrical components is simple, and troubles can usually be located quickly with the proper methods of tracing. Components are easily replaced without disturbing the remainder of the system. Comparatively little preventive maintenance is required for electrical components. Push-button control relays, solenoids, etc., are designed for thousands of operations. Motors, properly selected and installed, give many years of service with seldom more than periodic greasing.

General preventive maintenance of electrical con-

Concluded on page 58

How serious is the problem of explosion caused by a spark from a solenoid operated valve? Check the location of the equipment. If the atmosphere is rated hazardous, here's what you can do.

Do You Need an EXPLOSION-PROOF Circuit?

A SPARK in a dust laden atmosphere has been the cause of damaging explosions. With proper selection of hydraulic valves, you can prevent explosions caused by electrical actuation. While explosion-resistant solenoid operated valves are not always "off-the-shelf" items, suitable control valves for safe operation in hazardous atmospheres are available.

When the operation can be manually controlled, the explosion hazard may not be present. However, when automatic, remote controlled operation is required, safe valving must be selected.

> In a plant working with reclaimed rubber, a complete conveyor system was developed using oil pilot operated valves and roller operated valves to avoid the possibility of explosion. In a plant working with linoleum, a similar oil operated valve system was worked with the solenoid actuated pilot valves in an area remote from the actual machine so that the possibility of explosion was reduced. A third user installs his solenoid-operated valves in a dust tight cabinet to avoid contamination from external atmospheric dust.

These three users have successfully eliminated a real hazard. However, if your system doesn't permit the use of mechanical actuation, remote location or cabinet enclosures, what's available?

You could order solenoid operated valves designed to conform with the standard for industrial control equipment for use in hazardous locations which has been prepared by the Underwriters' Laboratories. Or another type of explosion-proof valve uses diaphragm type air pilots to shift the valve spool.

Because valves which are designed to be explosion-proof cost more and are not as readily available as standard valves, the first question the user asks is: "Do I need explosion-proof valves?" Actually, the number of applications where such valves are needed is comparatively small. Their largest use is on equipment in arsenals, grain elevators, flour mills and chemical plants. These locations may fall into the category defined as Class 1, Group D in article 500 of the National Electrical Code—flammable gases or vapors are present in the air in quantities sufficient to produce explosive or ignitable mixtures. The code defines Class II locations as those where combustible dust fills the air. Valves designed to provide safe operation in Class I locations will also be suitable for Class II.

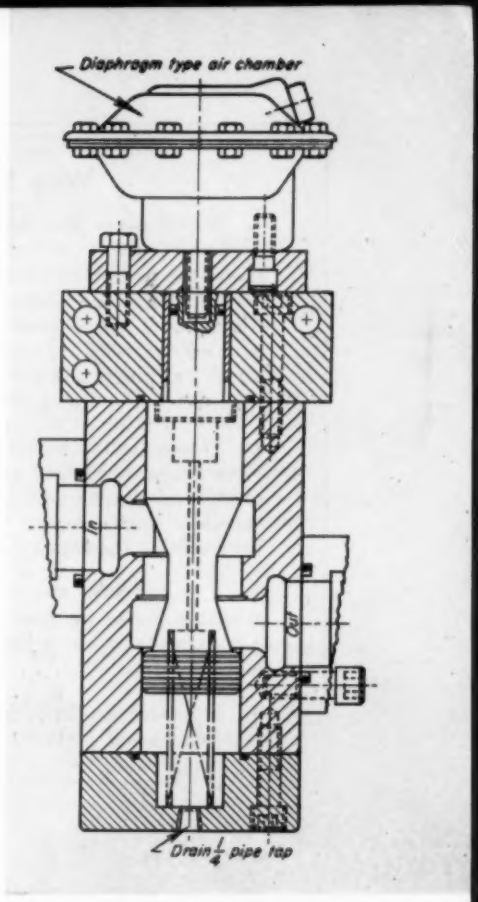


FIG. 1. The 2¼-inch diameter spool in this normally open shut-off valve is shifted to the closed position by air pressure acting on the air driven piston. 14 cubic inches of 75 psi air are used to completely shift the spool. Double A Products Co.

Therefore, to determine whether or not explosion-proof valves are needed, it is necessary to know the type and amount of contamination in the atmosphere—must the system operate in a hazardous location?

WHAT TO LOOK FOR IN VALVE DESIGN

The Underwriters' Laboratories has studied causes of fires and explosions and, based on these studies, has set up a standard for industrial control

Concluded on page 111

Why Should Rotary Fluid Motors Be Used?

1. Where space and weight at the power application point are important, high horsepower can be obtained from a small package. For instance, a one hundred horsepower electric motor is hardly practical when attached to a moving head on a machine. Sometimes a rack and pinion with a fluid motor will fit in the space better than a cylinder.

2. Where rotary motion is required, it is often better to replace a hydraulic cylinder, rack, and pinion with a fluid motor even though a gear reducer is needed to obtain the mechanical advantage.

3. If a hydraulic power source is already available, it may be more economical to add a hydraulic motor rather than an electric motor.

4. It is much simpler to transmit fluid power than mechanical motion to moving heads or to distant locations, as compared to shaft, gear, belt and sheave drivers.

5. Within maximum and minimum limits, an infinitely variable speed range is easily obtained. This is difficult either electrically or mechanically.

6. On mobile equipment, hydraulics is the only practical medium for powering accessories. It is versatile—many jobs may be accomplished with the same pump by merely changing hose lines. Large horsepowers may be developed without large, cumbersome pumps.

7. Within limits, speed synchronizing, fast accelerations, fast cycling, and diversion of one source of power to many points of application are all within the scope of hydraulics. The valving problems are still relatively simple compared to other methods.

One of the most misunderstood fluid power components is the rotary fluid motor. Here is an article aimed to help you select and apply fluid motors to their greatest advantage. With fluid motors, many "impossible" jobs have been conquered and difficult jobs have been made simple.

HYDRAULIC MOTORS

● By R. C. Burnham

SEVEN important reasons for selecting fluid power drives are listed in Table 1. Efficiency, unfortunately can not be included. The hydraulic system looses efficiency because of conversion of power from the prime mover to fluid power (through the pump) and then from fluid power back to mechanical rotation. Also, efficiency is often reduced by losses over overload relief valves, flow control valves, pressure reducing valves, and through system piping.

There are several general types of fluid motors available—gear, vane and piston. Each has certain inherent characteristics which should be understood to insure the best selection.

R. C. BURNHAM, *Manager, Hydraulic Div., J. N. Fauver Co., Inc., Detroit, Michigan.*

GEAR MOTORS

The gear motor is the simplest and probably most used because of economy. Figure 1 shows two gears in a closely fitted housing almost identical to a gear pump. Torque is applied to the shaft because of the extra tooth area pressurized when not in mesh. Gear motors may have spur, helical, or combinations of internal and external gears.

In general, gear motors are applied where economy is more important than efficiency and high power output. Inherently, the gear motor has high bearing loads at peak pressures tending to deflect the gears and shafts into the outlet side of the housing. At peak pressures, a gear motor may stall due to

the gear binding on the housing. Application of more pressure only locks the gears tighter after this point. The resulting wear reduces efficiency by increasing the clearance flow. Consequently, it is best to stay well within the recommended limits of pressure and power with gear equipment.

Due to relatively large clearances, the slippage or clearance loss is more on gear motors than on other types. For reasons that will be pointed out later, the minimum operating speed should be held to 400 rpm.

The gear motor does not start itself quite as well as others because of the variation in effective area of the teeth when in various angles of mesh. Where a maximum starting torque must be available, the gear motor is again ruled out.

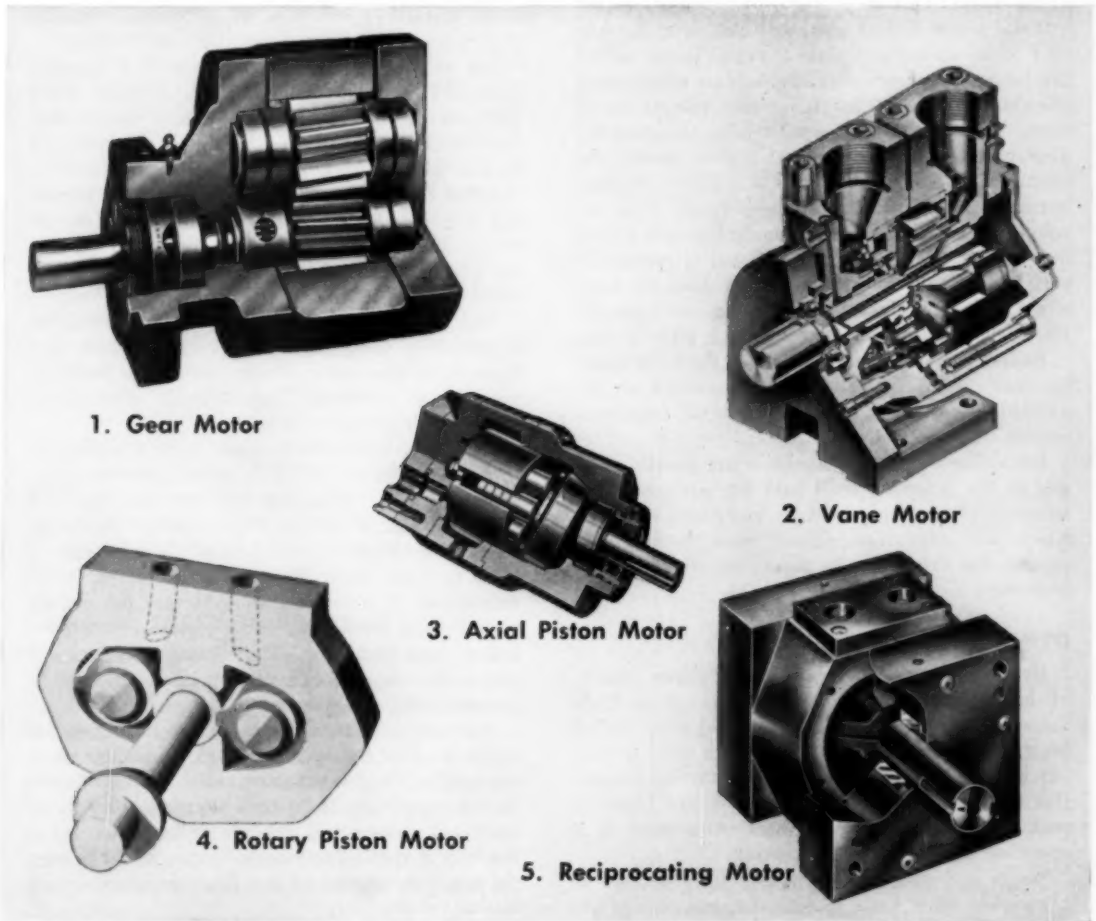
In spite of these disadvantages, the larger portion of jobs may be done well enough with this equipment. For mobile equipment where the speed of the prime mover varies, the motor often overspeeds. The gear motor will stand overspeeding better than other equipment. This often is an important selection factor.

VANE MOTORS

Figure 2 shows a vane motor which when compared to a gear motor, produces higher starting torques, performs better at peak loads, and gives higher efficiency. The price is somewhat higher, but not prohibitive for most applications.

The movable vanes reduce the clearance leakage, as compared to gear equipment, allowing speeds down to 200 rpm with reasonable results. Since each vane works twice per revolution, the bearing loads are minimized. In other words, pressures are equal and opposite on all sides of the rotor.

To start a vane motor, the vanes must be sealed against the cam ring preventing all of the oil from slipping to the outlet. There are various ways of accomplishing this. Some manufacturers use spring loading, some apply hydraulic pressure behind the vanes before admitting it to the working area, and



FIGS. 1 thru 5. Typical fluid motors used to convert hydraulic energy to mechanical torque. Photos courtesy of: 1. The Commercial Shearing and Stamping Company, 2. The New York Air Brake Company, 3. The Denison Engineering Company, 4. Berry Div., Oliver Iron & Steel Corp., 5. Roto-mation Motors, Inc.

others use novel devices such as rocker arms to force the vanes to follow the cam ring profile.

All vane motors must be kept full of oil to prevent cavitation which damages the internal parts. Therefore, circuits should never allow shutting off the inlet oil to stop the motor. A supercharging pressure of 50 psi or more depending on the make of motor should be provided. Sometimes this requires a more elaborate circuit with additional expense, but the cost is justified where fine control, high pressures, and better efficiency are needed.

PISTON MOTORS

Figure 3 shows one type of piston motor. This class of equipment is highest in efficiency, lowest in slippage, but most difficult to produce. The close tolerances and precision fits materially reduce slippage, which allows stable operation as low as 50 rpm. This precision also makes it the most costly of all motors excluding it from widespread usage.

Axial piston motors generate rotation as the pistons force an inclined plate to turn. These motors can be purchased with variable volume adjustments allowing the use of the full pump volume at all times. The speed is then regulated by changing the displacement of the motor. At higher speeds, the torque will be reduced, so this is a nearly constant horsepower motor within a speed range. Constant volume motors have nearly constant torque giving increases in horsepower proportional to speed. On variable volume motors, the torque does not actually follow a straight line curve due to losses in efficiency at high speed and low cam plate angles.

Radial piston motors have about the same characteristics as the axial except that volumes are increased by movement of the cam ring off from concentric with the shaft.

Durability of the piston motors are usually good due to the precision built into the equipment. In selecting piston equipment as compared to other types, the advantage gained must be weighed against the extra cost to determine whether it is necessary.

OTHER TYPES OF MOTORS

One manufacturer makes a "rotary piston" motor of heavy construction for transmission of high horsepowers, Figure 4. This motor has a loaded bearing and slippage equivalent to a gear motor, but it does have a more uniform starting torque. Due to the heavy construction it will run better at peak loads than gear equipment. Also there is a smoother action due to the porting.

Single and double vane motors for fractions of a complete turn have recently become widely accepted. This equipment might be called a rotary cylinder, since it has a positive stop after the fraction of a revolution and must be returned to its starting position before it can be rotated again. It has been used to replace cylinders for the purpose of conserving space, but it fits applications best where a fraction of a turn is required rather than a linear motion. It should be remembered that this equipment has internal leakage like all motors, possibly less severe, but line pressure should be maintained against it if it is expected to hold its load.

SLIPPAGE AND ITS VARIATION

Slippage might be defined as the volume of oil per unit time that flows through the motor without doing useful work. It is the clearance loss. This clearance in a motor resembles an orifice. Increases in pressure drop result in an increased loss roughly in proportion to the orifice formula. This means that if additional torque is demanded from the motor, the increased pressure drop required will increase the amount of slippage loss. For most applications at normal speeds, this loss is not a large enough percentage of the oil supply to affect the speed materially. Whereas, at low speeds, the slippage may be enough to stop the motor entirely.

For example, consider a motor with a displacement of 1 cu in per revolution. The slippage at full pressure may be one gpm in a gear or vane motor. Now assume that we are running at 100 rpm, low torque, and through a compensated flow control. We may be metering 200 cu in per minute. Supposing that we suddenly demand full torque on the motor. The flow metered by the control is less than the slippage of the motor, so consequently the motor stops.

This example indicates that low speed operation is definitely marginal. The allowable speed limit depends on the motor slippage as well as possibilities of load variation. The allowable speed variations also enters into the selection.

Low speed operation is made more marginal by slippage variation. With a given pressure drop across the motor, all motors slip more in some shaft positions than in others. High slippage points are sometimes called "sneak circuits" because the oil tends to short circuit through the increased orifice rather than to turn the motor. At very low speeds, a motor may break loose for a portion of one revolution, and then stop. These conditions are not noticeable when motors are operated above their recommended minimum speed.

When a motor fails to turn due to insufficient oil input, it gives the appearance of inadequate starting torque. This leads to a criticism from users who do not completely understand slippage. Actually an increased volume will produce full torque, but at too high a speed. Inadequate torque would prevent the motor from starting at a given pressure regardless of volume.

Servo controls are often used successfully to control at less than normal speeds. In this case, the servo would increase the volume of oil applied until

the desired reaction was achieved. The efficiency and accuracy of the servo system would then vary according to the slippage.

One manufacturer uses an electrically controlled vibrating valve to control a motor on a follower. Displacement of the tracer determines the position around which the valve pulsates. If an immediate motor reaction is not achieved, the tracer will be displaced more giving adequate volume to move the motor. The reaction releases the tracer tension causing the valve to vibrate around a central position.

So there are exceptions to the minimum speed rules, but the motor manufacturer should be called in for his recommendations before attempting a questionable application.

DECELERATION AND BRAKING

Many motor applications require braking or deceleration to hold or stop loads. Due to slippage, a tight lock cannot be guaranteed on any motor. A motor may be used to decelerate to a low speed, but a mechanical brake is best to stop and lock a load. Motors attached to a locking gear train have even been known to slip due to vibration which again illustrates the need for a positive brake. The only departure from this would be if a motor could be held against a positive stop by line pressure.

Deceleration to the near stopped position is accomplished by converting a motor into a pump. A pressure control in the outlet of the motor will result in reversed torque. The oil supply to the motor must still be maintained by a supercharge pressure of 50 to 200 psi to assure that the system remains full of oil. This varies with the application and motor design. Loss of supercharge means cavitation or vane collapse, loss of braking action and probable damage to the motor.

Two circuits for acceleration, coasting and braking are shown in Figure 6 and 7. In Figure 7 relief valve venting to drop the pressure and deventing to increase pressure is used. The smooth application of pressure by this method has many virtues in motor circuits, giving better control on acceleration and deceleration without shock.

VARIABLE TORQUE AND SPEED

A common misunderstanding of hydraulic motors is in the relationship of torque, speed and power. On most motors, a wide range of speeds are available at a constant torque. This means that horsepower increases directly with speed. In the variable volume motor, the horsepower is relatively constant, but only in a small range of speeds. At maximum motor displacement, there is a minimum speed depending on the relative pump size and below this speed, the horsepower would reduce proportional to speed.

What's the difference between a torque converter and hydraulic motor? The torque converter can de-

Concluded on page 59

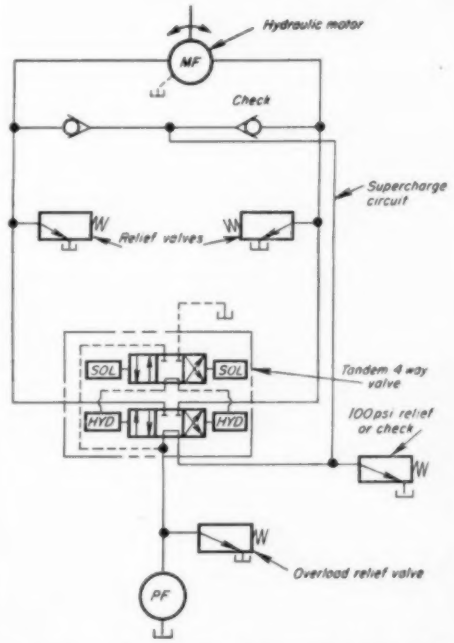


Fig. 6. Deceleration of this reversible motor is controlled by the setting of the relief valves.

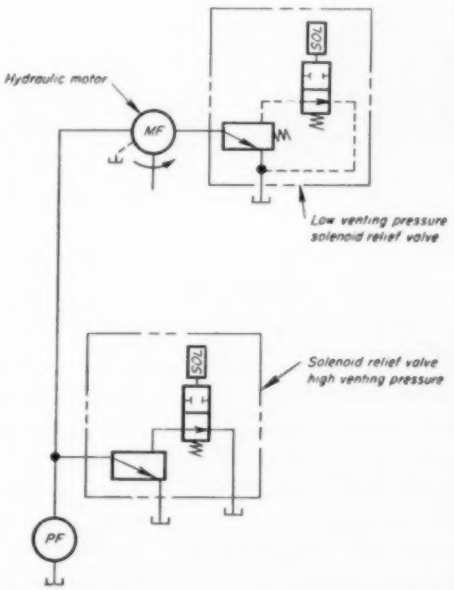


Fig. 7. One direction motor can be controlled by the use of venting valves.

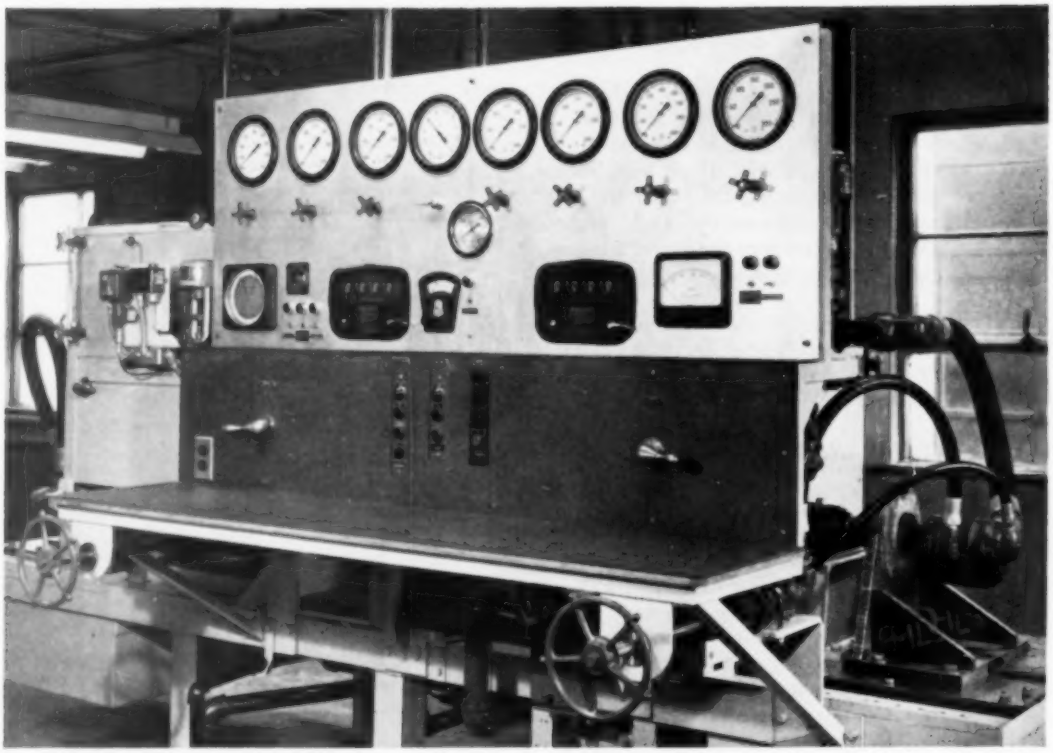


FIG. 1. CALIBRATION tests on pumps are run with this equipment. Pump drive speed can be varied from 0 to 3600 rpm. Pressure range to 3000 psi. Total flow and time can be recorded; oil temperature can be regulated; horsepower input measured.

Equipment for Pump and Motor Performance

Table 1 Performance Specs

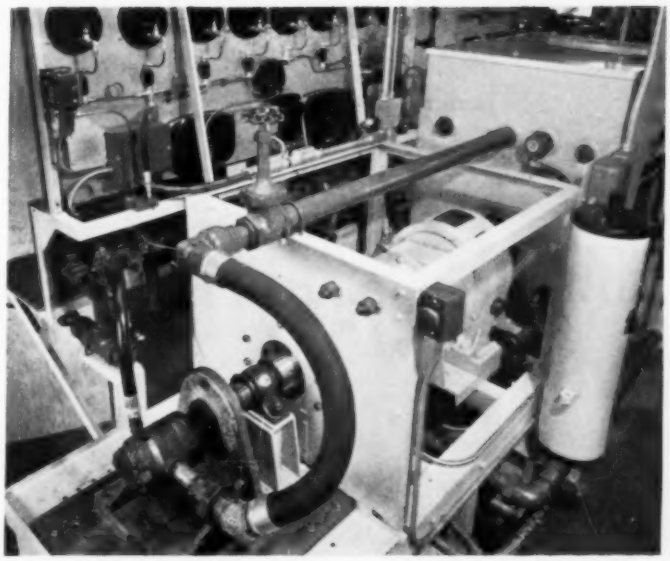
Pumps	Fluid motors
Speed range—rpm	Speed range—rpm
Max. operating pressure—psi	Max. operating pressure—psi
Delivery—gpm over entire speed range	Displacement per rev over entire speed range
Delivery—gpm over entire pressure range	Torque output—lb-ins over entire pressure range
Horsepower input over pressure range	Horsepower output over pressure and speed range
Overall mech. efficiency	Overall mech. efficiency
Volumetric efficiency	Volumetric efficiency

● By Robert Schwary

A large investment in test equipment is required to carry out a development program for fixed displacement pumps and motors and to supply the user with necessary preformance data. Table 1 lists the usual performance information which is desired. Few, if any of these specs could be reliably determined without actual test setups. Plotting this data to prepare performance curves provides

ROBERT SCHWARY, *project engineer, Hyrdeco Division, The New York Air Brake Company, Cleveland, Ohio.*

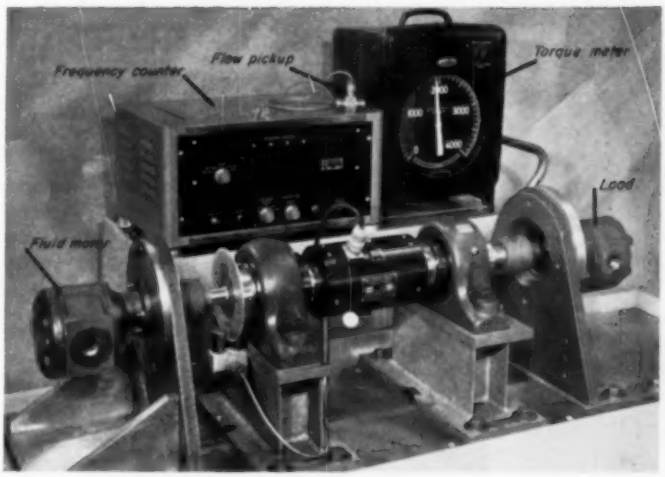
FIG. 2. REAR view of stand shown in Figure 1. Two pumps can be tested at one time at fixed speeds.



valuable information for both the pump designer and user.

Because pump life can only be determined by actual operation, endurance tests are an important job for which equipment is specially set up. The block drawing illustrates the elements used for an endurance test of two pumps. Pump load is determined by the relief valve. This load is cycled from relief valve setting to the zero unloading pressure by automatically energizing and deenergizing the vent valve. ▼▼▼

FIG. 3. WHEN COMPLETELY PIPED, the unit on the right is a pump which acts as a load for the fluid motor. Fluid motor speed and torque output is measured. The torque pickup, mounted between the pillow blocks, uses a strain gauge as a sensing element. The signal from the strain gauge is fed into the torque meter which converts this signal into a direct reading of inch-pounds. Speed is measured accurately down to one rpm by using the photoelectric cell in conjunction with the slotted disc to record impulses to an electric frequency counter. In operation, the flow pickup is piped into the discharge line from the fluid motor. It produces electrical impulses at a frequency proportional to flow. This frequency is counted on the frequency counter to provide a rate of flow measurement.



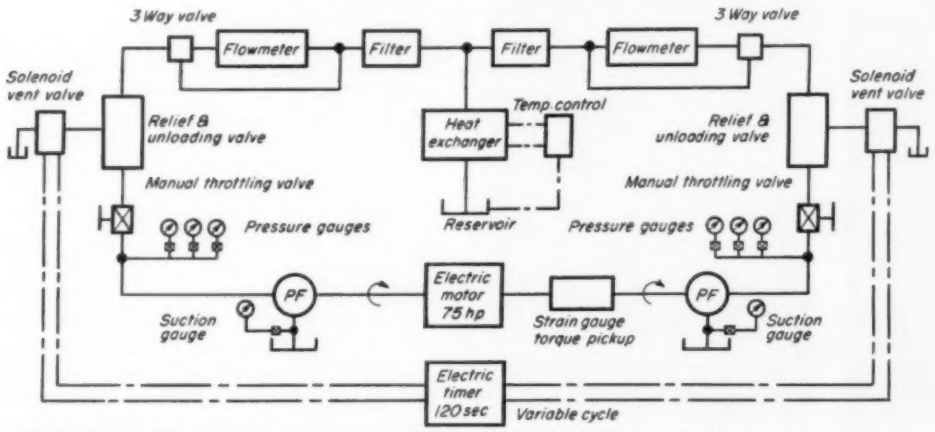


FIG. 4. RELIEF VALVE setting is the pump load. This load is cycled on and off by the timer actuated vent valve. Torque input is measured by the strain gauge pickup. Manually operated 3-way valves are used to divert flow through the flow meters when flow measurement is desired.

Is high pressure testing one of your jobs? Here's the design story of a 100,000 psi generator. While this equipment can be used for static tests, its main purpose is to perform a test requiring rapid release of the high pressure.

HOW TO GENERATE AND RELEASE 100,000 PSI

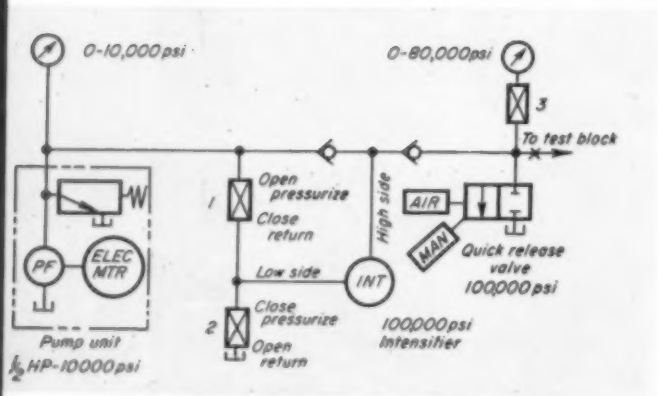


FIG. 1. CIRCUIT for the 100,000 psi generator. Valves 1, 2 and 3 are hand valves which require very little turning effort.

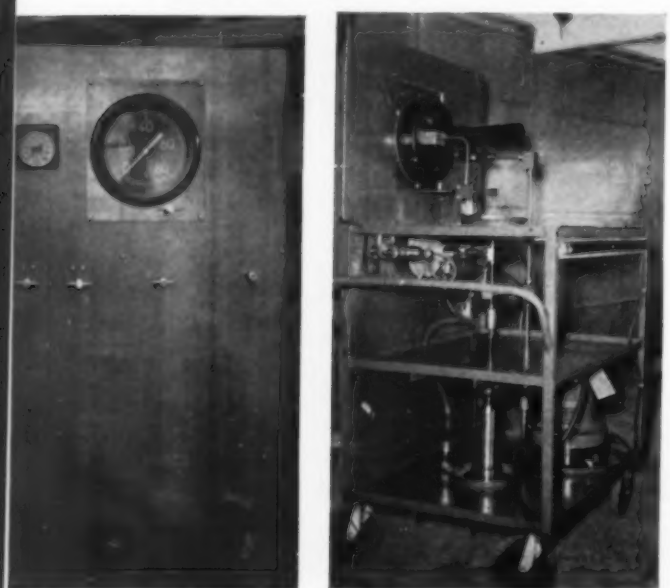


FIG. 2. ALL COMPONENTS are mounted in the portable rig. The 10,000 psi pump and the 13:1 intensifier are seen on the bottom shelf.

• By Robert W. Ellison

DESIGN of a high pressure testing unit was undertaken for the dynamic calibration of quartz (piezoelectric) piston pressure transducers. These transducers, which are widely used in ordnance, respond to frequencies well above 20,000 cycles per second and may be calibrated by applying a sudden step-change of pressure. The specially designed step-pressure generator has proved useful for in-place calibrating of quartz piston gages, and has been used for static testing to 100,000 psi. In calibrations, the unit has generated typical pressure steps of 50,000 psi with rise times of 1.5 milliseconds. These values were obtained with relatively large capacity systems, but nevertheless, correspond to time-rates of pressure change exceeding 30,000 psi per second.

FLUID SELECTION

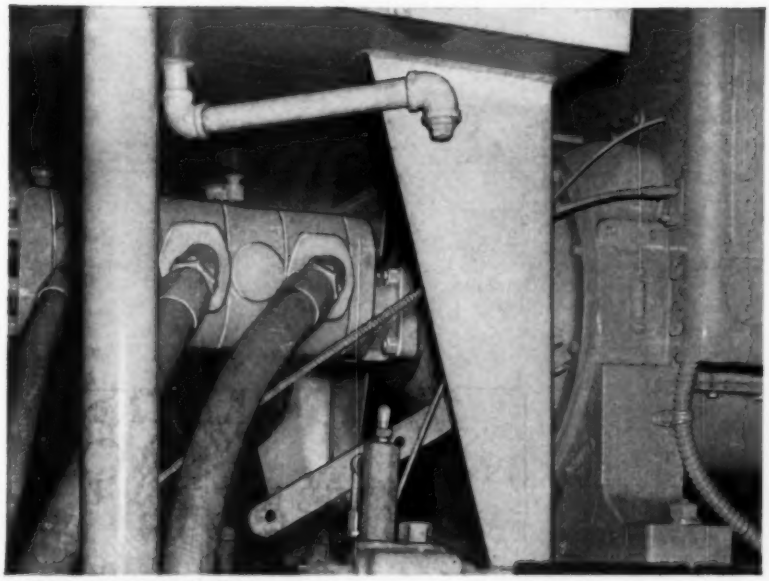
The problems encountered in this work included a major difficulty in the selection of a satisfactory hydraulic fluid as well as the development of lightweight, inexpensive components rated at 100,000 psi. The components have proved satisfactory from the earliest tests, but the hydraulic-medium problem has been complicated by a conflict between the needs for lubricating ability and the pressure-forced solidification of most hydraulic oils. The oil selection is still under study; however, DTE Light Oil has served at these pressures without exhibiting a prohibitive degree of pressure solidification.

Design of this calibrator was based on a single-fluid intensifier circuit to pressurize a minimum-volume space to 100,000 psi. The schematic diagram, Figure 1, depicts a conventional arrange-

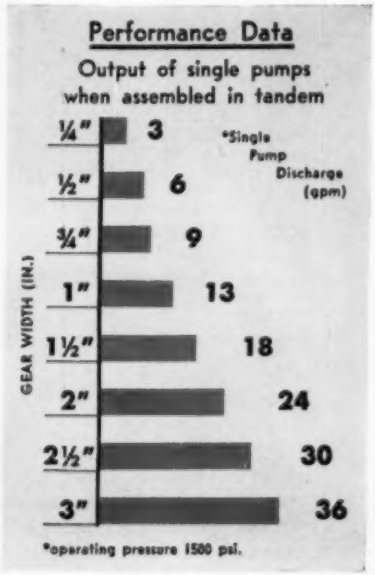
ROBERT W. ELLISON, *senior research physicist, Reaction Motors, Inc., Denville, N. J.*

FLUID POWER NEWS

THREE PUMPS— ONE POWER TAKE-OFF



COMPACT TANDEM MOUNTING driven thru one power take-off. Three power packed hydraulic circuits operate independently from the output of these three single pumps.



How complicated engineering problems are solved in designing hydraulically powered, multi-functional heavy duty equipment.

More manufacturers adopting tandem oil hydraulic pumps to turn out more work with less operator fatigue.

If you have problems in designing hydraulic circuiting into your hydraulic powered equipment because of its multi-functional operation, look how the "Commercial" tandem oil hydraulic pump will give you the necessary output to energize more than one cylinder or motor independently of each other at substantial savings in cost.

Independent control of snow plow blade and wings, earth mover boom and tool, conveyor and spinners of ice control spreaders, or tool operation on power steered mobile equipment are merely a few applications where these pumps deliver fluid power to every separate hydraulic circuit required for all these functions. Each operation is individually controlled, yet when speed change is needed for better intermittent tool operation, the combined output of two or more pumps can be easily obtained with simple valving. You do not have to over-power your entire circuit in order to satisfy an intermittent overload developed in any part.

TOUGH DIGGING in close quarters with this multi-purpose machine is only possible because of its finger-tip controlled hydraulic operation.

Two, three, or even as many as four pumps, assembled with parts common to single pumps, can be strung out behind one shaft—the whole assembly requiring only one mounting. How much more complicated it would be to mount individual single pumps, each requiring a separate power take-off, for every hydraulic operation. Think how much less space one tandem would occupy, and can't you readily visualize how simplified your piping and valving problems become.

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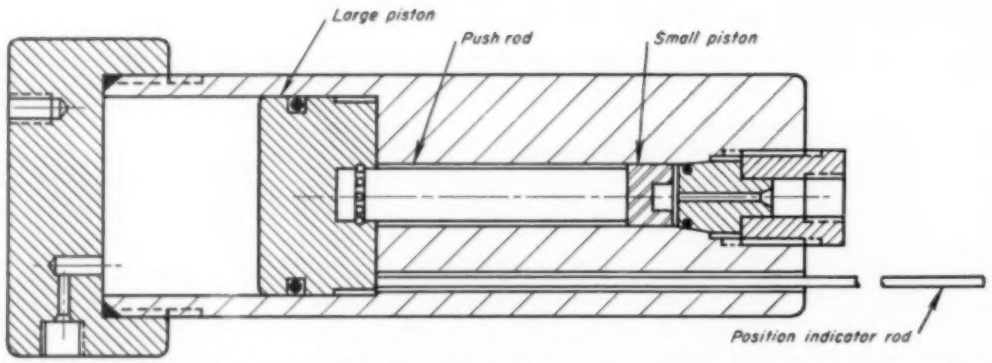


FIG. 3. INTENSIFIER HAS a one piece high tensile steel body. Push rod transmits mechanical force and movement between the large and small pistons. If any leakage should occur it is vented to atmosphere through the long weep hole parallel to the axis. A loose rod in this hole indicates position of the larger piston.

ment for this purpose and shows in addition, means to effect sudden release of the entrained liquid pressure. The design was based on components which could be obtained commercially and resulted in the portable apparatus shown in Figure 2.

Low pressure (under 10,000 psi) components used are well known and are adequately described in the notes included on the schematic diagram. The extreme pressure components, however, are somewhat unusual. Figures 3 and 4 show the designs of the intensifier and quick release valve.*

The intensifier, Figure 3, consists of a one-piece body of hightensile steel containing a 2¾-inch diameter low-side piston driving a ¾-inch diameter piston by means of a simple loose-attached push rod. The pistons are returned through a 2-inch stroke by supercharging action from the 10,000 psi oil pump. The geometric area ratio is greater than 13:1 and provides for friction effects far in excess of actual values encountered at rated pressure, 100,000 psi. Commercial seals, manufacturer-rated for 5000 psi service, perform well for both the high and low pressure pistons.

PRESSURE GAUGE PROBLEM

In the course of initial tests with this unit a water-soluble hydraulic fluid was used to transmit discharge pressure to a Bourdon gauge. The pressurization proceeded nicely to about 60,000 psi. At this valve the Bourdon gauge stopped. Diassembly of the intensifier showed some distortion of the push rod indicating that pressures to at least 130,000 psi had been generated. The failure of the Bourdon gauge to move was subsequently traced to

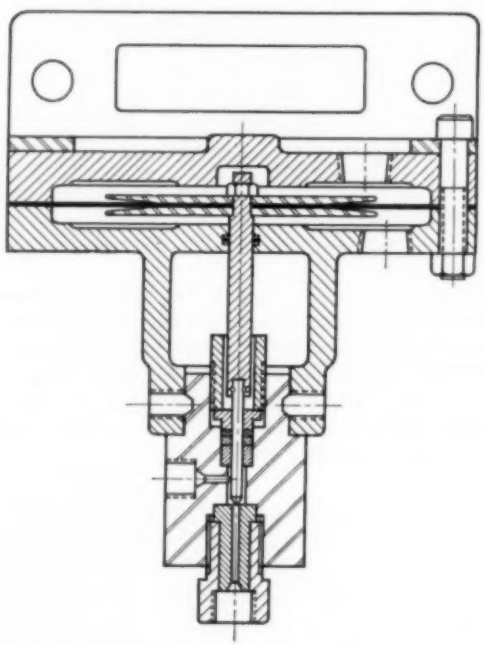


FIG. 4. FAST RELEASE of high pressure liquid is obtained with this air operated valve.

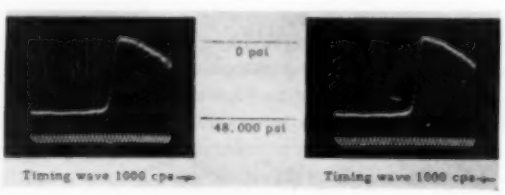
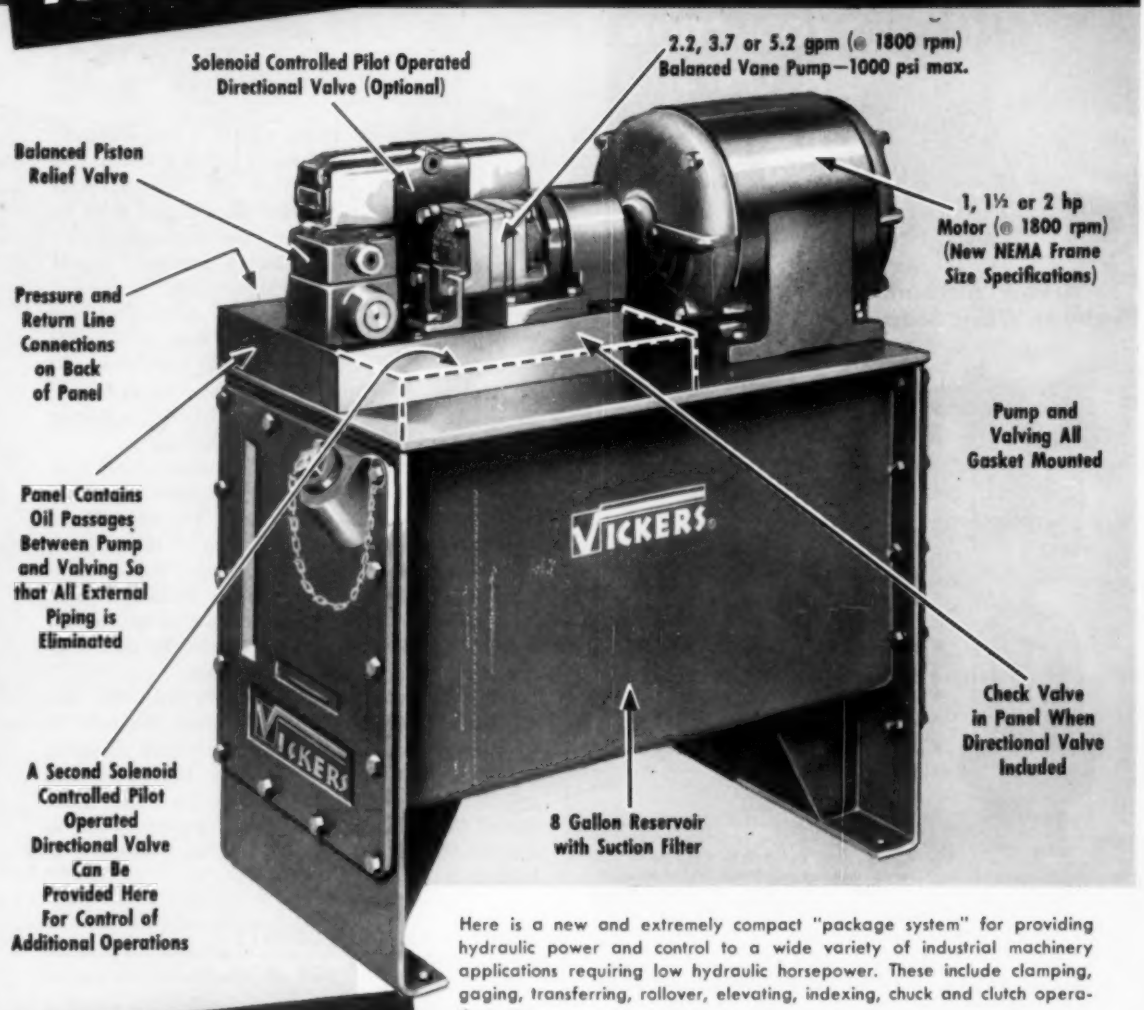


FIG. 5. OSCILLOGRAMS show rapid pressure release.

* *All high pressure parts were developed and supplied by Pressure Products Industries, Hatboro, Pa. Their design data is gratefully acknowledged.*

A NEW IDEA . . . in hydraulic power and control systems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Balanced Piston Relief Valve
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100,000 PSI EQUIPMENT

emulsification of the hydraulic fluid and its solidification. This effect in turn had completely prevented transmission of gauge pressure through the capillary tubing used. Subsequent tests with larger diameter (⅛-inch I.D.) tubing were successfully made to pressures of 120,000 psi using DTE Light Oil. No leakage was found in repeated tests over eight hours.

The quick release valve, Figure 4 was designed to provide the fastest release of liquid feasible. The rapid action of compressed air was combined with oversize penumatic valves and plumbing to drive an eight-inch diameter diaphram; the diaphram in turn drives a hard alloy stem (⅛-inch diameter) to seal against the seat of the 100,000 psi valve. The conical stem tip (stellite) seals against a cylindrical seat 0.070 inch diameter. Pressures as high as 100,000 psi are held, leak free, by air pressures under 40 psi. Operation of the oversize air valve release diaphragm pressure with speed sufficient to release oil pressure in less than 1.5 milliseconds.

The only mechanical difficulty encountered with this apparatus resulted from inadequate protection of an 80,000 psi Bourdon gauge. The first release of pressure resulted in rapid drop of the pointer, and the ensuing overswing damaged the connecting link. Installation of a manual shutoff valve in the gauge line prevents recurrence of this effect since the gauge pressure is now carefully vented by cautiously opening this shutoff valve.

Dynamic tests were made initally with this unit directly coupled to a load-simulating reservoir (1 cubic inch). The oscillograms of pressure shown in Figure 5 were typical. In other tests with less attached volume, rise times less than one millisecond have been recorded anad pressure rates to 100,000,000 psi per second have been attained at highest pressures. ▼▼▼

ELECTRICAL COMPONENTS

Concluded from page 46

trol equipment should consist of a monthly check of the following:

a. Proper voltage for control circuit (control transformer secondary)
b. Dirt or foreign material on equipment
c. Excess heating of parts
d. Corrosion
e. Erratic operation
f. Loose connections
g. Worn or broken parts
h. Condition of gaskets for oil-tight, dust-tight, or water-tight equipment
i. Collection of moisture in enclosures
j. Proper functioning of timing devices, sequencing of operations, etc.

Dust should be wiped off regularly, and grease and oil should be removed with small amounts of carbon tetrachloride. Fuses should be removed from fuse holders and fuse ferrules should be polished (except silver plated holders and ferrules). ▼▼▼

Concluded from page 51

liver full horsepower at low speeds with very high torque. A hydraulic motor has a given maximum torque and this same torque is available over a range of speeds depending on the hydraulic pressure applied. When a motor is geared down for full horsepower at low speed it is not useful at high speed without a variable speed gear box since rated speed and pressure are required at low speed to obtain the horsepower. Any increase in speed would overspeed the motor.

Variable volume equipment and series-parallel circuits make certain ranges possible at constant horsepower, but only when oversize equipment provides full horsepower at less than maximum speed. The cost of oversize equipment is usually prohibitive.

EFFECT OF SPEED ON EFFICIENCY

Basically, the volumetric efficiency of a pump and motor combination depends on the percent of the pressure and volume of the total output going into useful work. Efficiency is low at very low speeds because the slippage is too large a portion of the total volume supplied. For a given pressure, this slippage remains fairly constant over the speed range and therefore higher speeds allow better efficiency.

There is another factor causing some loss of power as the speed increases. Again comparing the motor to an orifice, there is a pressure drop due to the volume of flow through the motor. The higher volumes result in more pressure drop in the approximate ratio of the orifice formula. This means that for high speeds less and less of the applied pressure goes into useful work. This pressure drop might be 10 psi per 100 rpm speed increase, which will give an idea of the magnitude of this loss.

EFFICIENCY AT LOW PRESSURE

Nearly all fluid motors require 100 or more psi to start, no load, and show little reduction in no load pressure after breaking loose. Obviously, this represents a loss and at 100 psi the efficiency would be zero since there is no load. When loading up the motor, the efficiency obtainable is dependent partly on the system pressure. If the system pressure of this motor was 1000 psi maximum, it might be possible to obtain close to 90 percent efficiency if 100 psi is the no load pressure. Similarly, if the maximum pressure were limited to 500 psi, the maximum possible efficiency would be 80 percent. This indicates that efficiencies improve in the higher pressure ranges if the equipment can stand the extra load.

Due to the no load pressure requirements, the designer is often misled in calculating effective torques at low pressures. To be practical, the system should be designed to work at a higher pressure than theory indicates to assure adequate torque.▼▼▼

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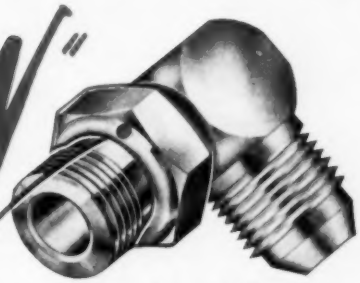

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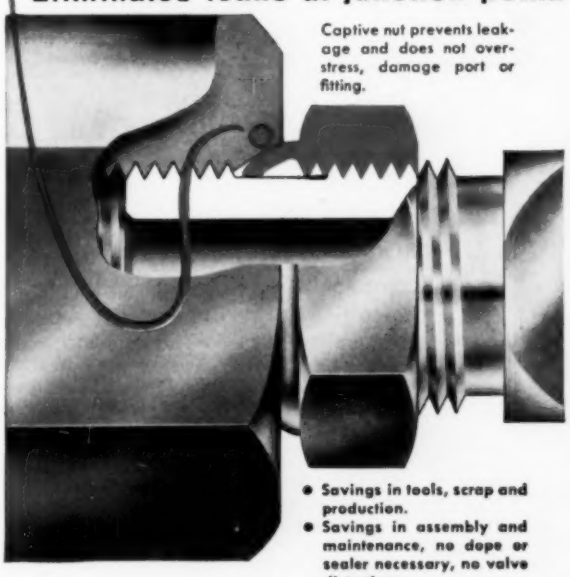

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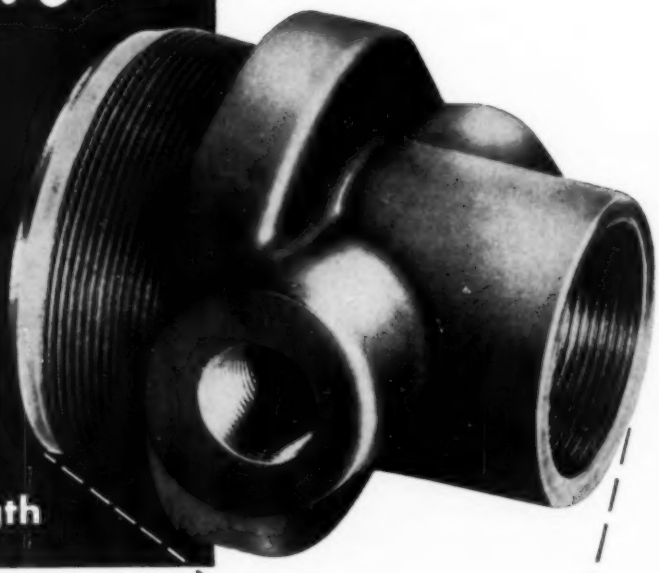

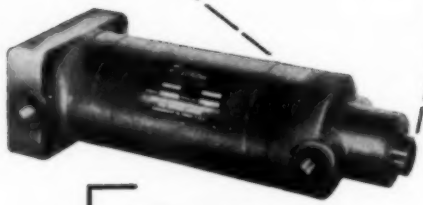

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"Spiral failure" of an O-ring is caused by internal weaknesses as well as gland design and application. Here's the story of a new technique in O-ring manufacture which is aimed toward . . .

INCREASED O-RING LIFE

• By Gilbert C. Close

WHEN about 15 years ago hydraulic O-rings first appeared for use in critical aircraft hydraulic systems, the simplicity of the O-ring itself, the simplicity of its installation, and the design simplicity of the hydraulic glands in which it could be used, soon lead to its adoption in many fields where hydraulic equipment and systems were employed. From the very start, this increasing demand for the product placed heavy responsibilities on the O-ring manufacturers. Aside from producing O-rings in ever increasing numbers, a specific high quality level had to be maintained because many O-rings are used in installations where sudden failure can be costly and sometimes extremely dangerous.

Also from the very start, these O-ring manufacturers had to battle a common enemy to consistently high O-ring quality—the problem of spiral failure. This was a particularly vicious problem because spiral failure is not caused by poor O-ring material or laxity in manufacturing methods or techniques. It is caused instead by weaknesses in the O-ring structure itself which in turn are inherent results of the older conventional molding processes used to produce O-rings up until this time.

The new Dauby Process for molding rubber, now in use at Plastic and Rubber Products Company, Los Angeles, overcomes this problem by eliminating structural weaknesses which caused spiral failure.

To appreciate the importance of this new development, let's delve a bit deeper into spiral failure, its cause, and how it was cured.

Any rubber molding process involves a time-temperature-pressure element. The rubber, in a rough state, must be held for a certain time at a certain temperature and under enough pressure to cause it to flow and fill the die cavity in which it is being molded. In compression molding a roughly-shaped over-size approximate of the part to be molded is placed in the die cavity, then the die is closed and pressure applied. This pressure causes the heated rubber to flow and fill the contours of

A SHEET OF RUBBER is placed between the parted die halves of molding machine used in the new process for molding rubber. When the die is closed, each die cavity "cuts its fill" from the rubber sheet.

ONE HALF of a multiple O-ring die used. Geometrical design of the die cavity mating edges assures cutting of just enough material to fill the die cavity. Thickness of the sheet from which the material is cut is not critical.

the die cavity. Excess rubber is extruded in the form of "flash", which is later removed by hand.

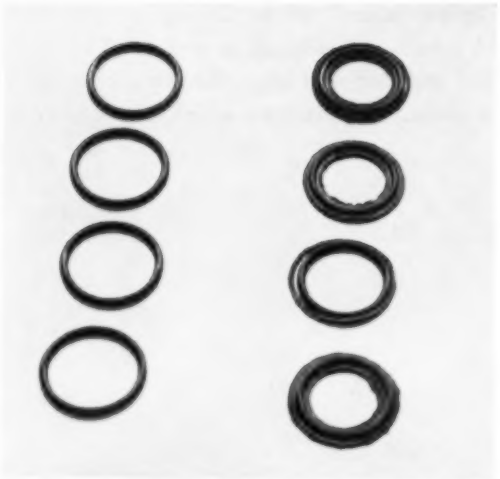
In injection and transfer molding, the rubber is forced into the die cavity through an orifice until the die cavity becomes filled. In all three types of molding—compression, injection, and transfer—the dies are hot when they are filled. In compression molding, there is an appreciable time lag between the time the rough part is placed in the die cavity, and until the die is closed and placed under pressure. In either injection or transfer molding, there is a time lag between the time the raw material starts to enter the die cavity and until the die cavity is full. Thus with any of these conventional processes, it is evident that some of the rubber that will compose the finished products comes into contact with the hot die metal before the rest of it does.

As a result, the material that contacts the hot die metal first starts to vulcanize immediately. It becomes at least partially solid, and the material that flows to fill out the die cavity must flow around this initially vulcanized mass. This results in planes or laminations forming within the product as the more plastic material flows around and over the partially vulcanized material.

A certain amount of molding pressure is used to assure complete filling of the die cavity, and the various laminates of material within the product vulcanize or "sets" firmly in the dimensions dictated by this applied pressure. When after vulcanizing is completed, this pressure is removed, the molded material attempts to readjust itself to dimensions compatible with zero external pressure. But this readjustment of dimensions does not occur as a body, but along the various laminates that were formed during molding. The net result is a series of stress set-ups along the planes of lamination within the body of the material. In many cases the total of these entrapped stresses will approach 50 per cent of the total elastic strength of the material. Thus, when an additional work load equal to only 50 per cent of the strength of the material is applied, the work load plus the entrapped stresses are equal to 100 per cent of the elastic strength of the material.

. . . new process eliminates three operations: cutting "roughs," placing roughs in die, stripping flash

It is quite obvious from the above that this 100 per cent loading occurs only along the planes of lamination within the material where the 50 per cent work load encounters the entrapped stresses that total 50 per cent of the elastic strength. Thus severe deformation occurs along these planes, and after repeated loading, failure will start. The term "spiral failure" derives from the shape of the defect as it progresses through the material along these laminated planes.



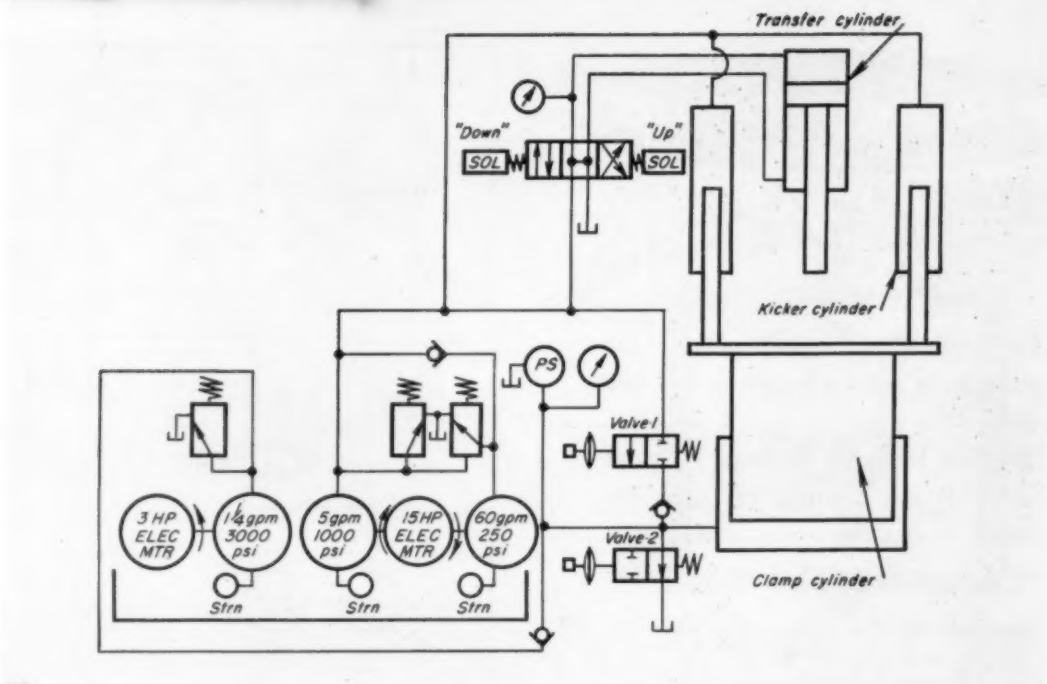
(LEFT) O-rings "as produced" by the Dauby process. Note absence of "flash" that would require hand-stripping. O-rings produced by compression molding before stripping of "flash".

All photos by author

The word "normalized" was selected to describe the O-rings produced with the new Dauby Process because during molding no internal stresses are generated within the structure of the O-ring during the vulcanizing process. In relative comparison, these O-rings are like steel parts that have been "normalized" after heat treatment to relieve the internal stresses and strains.

While the Dauby Process is patterned in some respect after conventional compression molding, it accomplishes two all-important advantages. First, the time lag in filling the die cavities has been reduced to a vanishing point. Thus none of the material has time to become even partially vulcanized before the die cavity is filled. Secondly, the amount of material that enters the die cavity is exactly equal to the amount of material required for the part and fills the die cavity without the aid of external pressure during vulcanizing. Thus, when the pressure on the mold is released after vulcanizing is complete, there is no tendency for the molded material to readjust its dimensions, and no laminated planes within the material along which entrapped stresses can occur in case even a slight readjustment is necessary.

Using a normalized O-ring permits increased work load from 50 to about 90-per cent of its elastic limit without increasing the danger of spiral failure. ▼▼▼



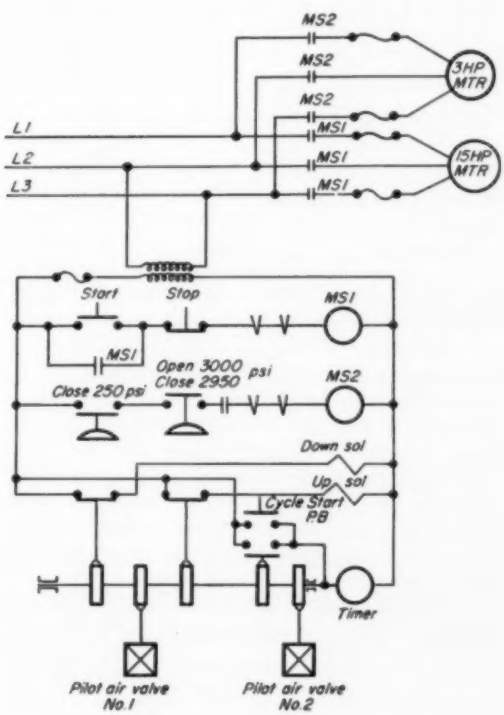
CLAMP AND TRANSFER pressures are independently adjusted. Pressure adjustment up to 1000 psi can be made on the transfer cylinder to handle different types of plastics. Oil flow to the clamp cylinder is controlled by poppet type 2-way air pilot operated valves. Proper decompression of pressure in the clamp cylinder is obtained by slowly opening valve 2. The circuit is arranged so that a minimum amount of power is required. The 60 gpm pump, used only for rapid closing of the clamp, unloads at near zero pressure when system pressure reaches 250 psi. The 3000 psi pump is stopped when clamp pressure is above 2950 si. Therefore, only the 5 gpm pump is operating at its maximum relief valve setting during the actual molding time. To open the press, oil in the clamp cylinder is free to flow to tank through valve 2 as pressure is exerted on the small diameter kicker cylinders.

POWER AND CONTROL for COMPRESSION PLASTIC MOLDING

• By Henry Green

Ackerman Plastic Molding
Div. The Consolidated Iron-Steel Mfg. Co.

CYCLE CONTROL of a 350 ton transfer press is established by a motor operated cam shaft timer. Pressing the cycle start button, starts the timer cam rotation to energize the transfer down solenoid and operate the air pilot valves. Large volume oil flows to the clamp cylinder. As the clamp closes, pressure builds up and the small volume high pressure pump goes into operation when a pressure switch closes at 250 psi. When clamp pressure builds up to 3000 psi, opening of a pressure switch stops the 3000 psi pump. High pressure oil is trapped in the clamp cylinder by check valves. Should clamp pressure drop 50 psi, the pressure switch recloses to start the pump again. With the clamp cylinder closed, the transfer cylinder completes its stroke.



Problem Clinic

Two cylinders operating from one pump were moving together. The user wanted the smaller bore cylinder which also had the heavier load to move faster. It was possible to revise the circuit to get the added speed without a second pump or an accumulator.

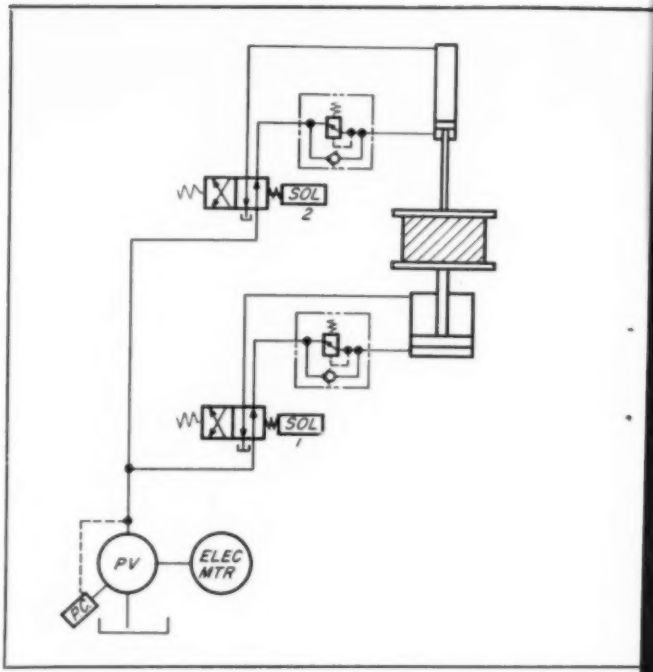


FIG. 1. ORIGINAL CIRCUIT did the job all right but when both valves are energized, as shown, oil flows to the lower cylinder because there is less resistance here. As the lower piston moves up it pushes the upper piston. The result is that both pistons move at the same speed.

Circuit REVISED for MORE SPEED

• By Harvey Barnes

OUR customer had been using the hydraulic circuit, Figure 1, with satisfactory results for some time. However, he discovered that his product would be improved if the upper cylinder could be retracted at a faster rate than the lower cylinder was extending. In addition to bettering the product, it was desirable to decrease the cycle time without increasing cost too much.

During the portion of the operating cycle we are concerned with, the upper cylinder must lift a heavier load than the lower cylinder, although the upper cylinder is of smaller bore than the lower cylinder. With the circuit shown in Figure 1, the oil takes the path of least resistance when the valves are energized and raises the lower piston. This piston pushes the upper piston rod up. Of course, both pistons raise at the same rate of speed.

Various possible solutions to the problem were discussed. Additional pump capacity did not seem to be the answer as it would increase cost too much and would only be required for a small percentage of the total cycle time. It seemed to be an accumulator job, but the ultimate users of the machine are of the rough-and-ready type, and many of the machines are to be used in remote areas of the country where necessary accumulator servicing is not readily available.

The idea of using the discharge oil from the rod side of the lower cylinder was suggested, and the circuit shown in Figure 2 was designed. This requires very few changes in the existing equipment. It adds valve 3 to a manifold, a check valve, and changed the piston rod diameter in the lower cylinder.

Selection of the piston rod diameter of the lower cylinder was based on two factors: the intensification necessary to obtain sufficient pressure in the rod end of lower cylinder to raise the upper cylinder and its load; also sufficient rate of flow from the rod end of the lower cylinder to cause the upper cylinder to raise at a faster rate than the lower cylinder.

Since the lower cylinder has the larger bore,

HARVEY BARNES, *sales engineer, S. G. Morris Co., Cleveland*

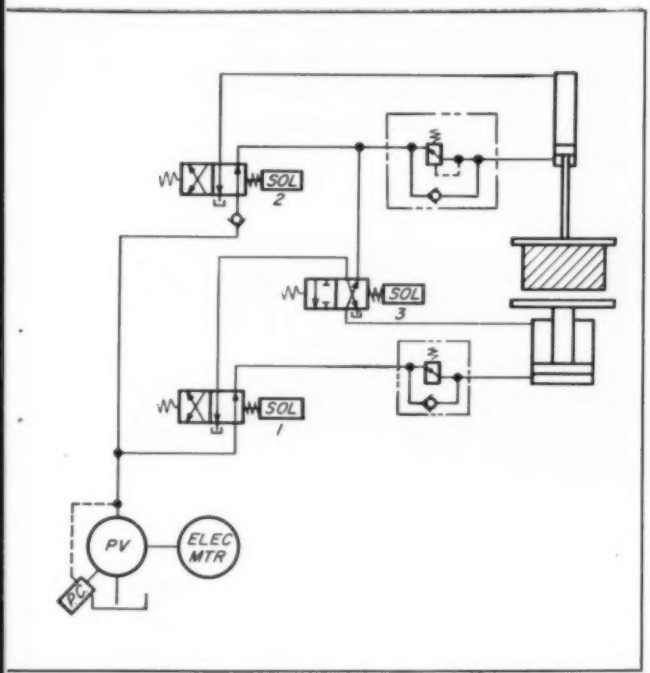


FIG. 2. REVISED CIRCUIT results in the upper piston moving up faster than the lower piston. The oil to accomplish this change is taken from the rod end of the lower cylinder. With this circuit, the cylinders are series connected until the lower cylinder reaches the end of its stroke.

increasing the rod diameter to intensify the oil output pressure still allows enough flow of oil to the upper cylinder to cause its faster motion. Also sufficient effective area is left to raise the load on the lower cylinder.

Piston rod diameter for the lower cylinder was selected so the total volume of oil from the rod side of the lower cylinder was less than required by the rod side of the upper cylinder. When the lower cylinder piston reaches the end of its up stroke, the upper piston still has some travel to complete. System pressure immediately rises to whatever is required by the upper cylinder to keep it moving up. The added check valve will open so the upper cylinder will continue to move up as oil is supplied directly from the pump.

The check valve forces the intensified oil from the lower cylinder to flow to the upper cylinder while both cylinders are rising. If it were not in the system, the oil from the rod end of the lower cylinder would back up and unite with the pump output, thus effecting a differential circuit on the lower cylinder. This would increase the speed of both cylinders but would not cause the upper cylinder to pull away from the lower cylinder.

Valve 3 is a modified single solenoid spring offset 4-way arranged so one cylinder port is blocked rather than connected to drain in the deenergized position. This is necessary to permit independent operation of the upper cylinder. ▼▼▼

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Cold Weather Operation of Hydraulics

ASK the driver of a snow removal bulldozer who has been having trouble with the hydraulics—how come? He's almost sure to say: "This below zero temperature makes the oil thick. Everything sticks—the valves and the cylinders. Pump gets noisy. But there's nothing wrong that a warm day won't cure." Which is all true, but—by the time that warm day comes hydraulic components on this bulldozer may be badly worn.

Getting the right oil and properly designed components and circuit is necessary. As the driver of the bulldozer said, viscosity is important. There has to be some compromise because although high viscosities reduce slippage and leakage, they also increase flu'd friction, and although low viscosities reduce fluid friction, wear of sliding parts may increase. So there's a compromise between operating efficiency, wear rate and speed of operation. Evaluation requires adequate testing of the hydraulic system at the low operating temperatures.

Information included in the article was made available by The Texas Company and Vickers, Inc.

What's the effect of cold weather on the pump? Suction developed by a vane, gear or piston pump may not be sufficient to draw a cold, highly viscous fluid into a hydraulic system steadily and smoothly. Here are the results of a laboratory study carried out by The Texas Co., to learn the effect of oil viscosity on the operating efficiency of vane type pumps.

The apparatus consisted of a double-acting vane pump driven at 1740 rpm to give a theoretical delivery of 7.8 gpm, with the necessary piping and valves to allow pumping from either of two reservoirs. A needle valve was used to produce the desired pressure at the pump outlet, while a relief valve prevented the application of excessive pres-

Hydraulic systems that must be started up at unusually low temperatures require oils of sufficiently low viscosity and pour point to assure adequate oil feed to the pump while the oil is cold. Hydraulic oils having high viscosity indices give the most assurance of good low temperature starting characteristics combined with adequate lubrication and a minimum of pump slippage at higher temperatures.

sure. A range of test viscosities was provided by varying the temperature of the apparatus and oil in a temperature controlled room.

Two oil reservoirs were located so that, when used to feed the pump, the starting oil level of one was 18 inches above the pump centerline, while that of the second was 18 inches below the centerline. These represent the usual extremes in reservoir oil levels encountered in service. A vacuum gage near the pump inlet registered the suction developed by the pump while in operation.

The pipe and fittings from the upper reservoir to the pump inlet were equivalent to approximately 8 feet of one inch iron pipe, while the pipe and fittings from the bottom reservoir were equivalent to approximately 13 feet of one inch iron pipe. Therefore, the positive static oil head as well as the lesser amount of pipe friction between the upper reservoir and the pump inlet was more favorable to pump operation than the condition offered by the lower reservoir.

One pump manufacturer recommends that the pipe or tubing leading into the pump inlet ports be straight for at least 20 pipe diameters to assure laminar flow into the pump. However, the test apparatus had a 90 degree elbow only three diameters from the pump housing inlet, which is typical of many systems in actual practice.

Five oils typical of those used in hydraulic service but of widely varying characteristics were used in the pump tests.

For a test run, the reservoir to be used as the pump feed tank was filled with oil, and then the apparatus and oil temperatures were brought to the desired test temperature in the temperature controlled room. Hook gauges in the reservoirs used in conjunction with a stopwatch, allowed flow rates to be measured at two successive outlet pressures. The test temperatures for each oil were lowered in increments until load pump noise and greatly diminished flow rate occurred. Pump noise level was evaluated by ear as being:

zero = low level of pump noise
a = smooth whine, higher noise level
b = whining, grating sound

As is generally recognized in the hydraulic field, pump noise of the "a" and "b" categories is generated by cavitation.

Oil flow in the test pump inlet and outlet lines was essentially viscous, except for possible localized turbulence caused by pipe fittings, since the calculated Reynolds Numbers were below 1500 in all cases.

The heating effect of the pump on the oil was less than 2°F because the test oil was not recirculated and because the short duration of each run did not give the pump a chance to warm up. Oil temperature rise through the inlet pump lines due to pipe friction was negligible. Therefore, the pump was operated solely under starting conditions, with the oil viscosity throughout the system remaining for all practical purposes the same as that in the feed reservoir.

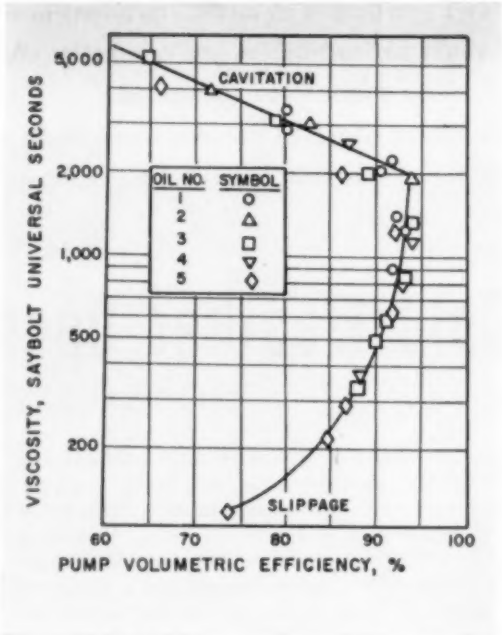


FIG. 1. Effect of viscosity on vane pump volumetric efficiency at 1000 psi with the reservoir located below the pump.

The curve of Figure 1 is a typical plot of the data illustrating the effect of viscosity on the volumetric efficiency of the vane pump. In this case, the data points adhere particularly close to the curve defined by them at the viscosity values below 1900 Saybolt seconds. Above this value, the rapid drop in pump efficiency reflects the onset of cavitation, and pump delivery becomes somewhat erratic as reflected by scattering of the data points.

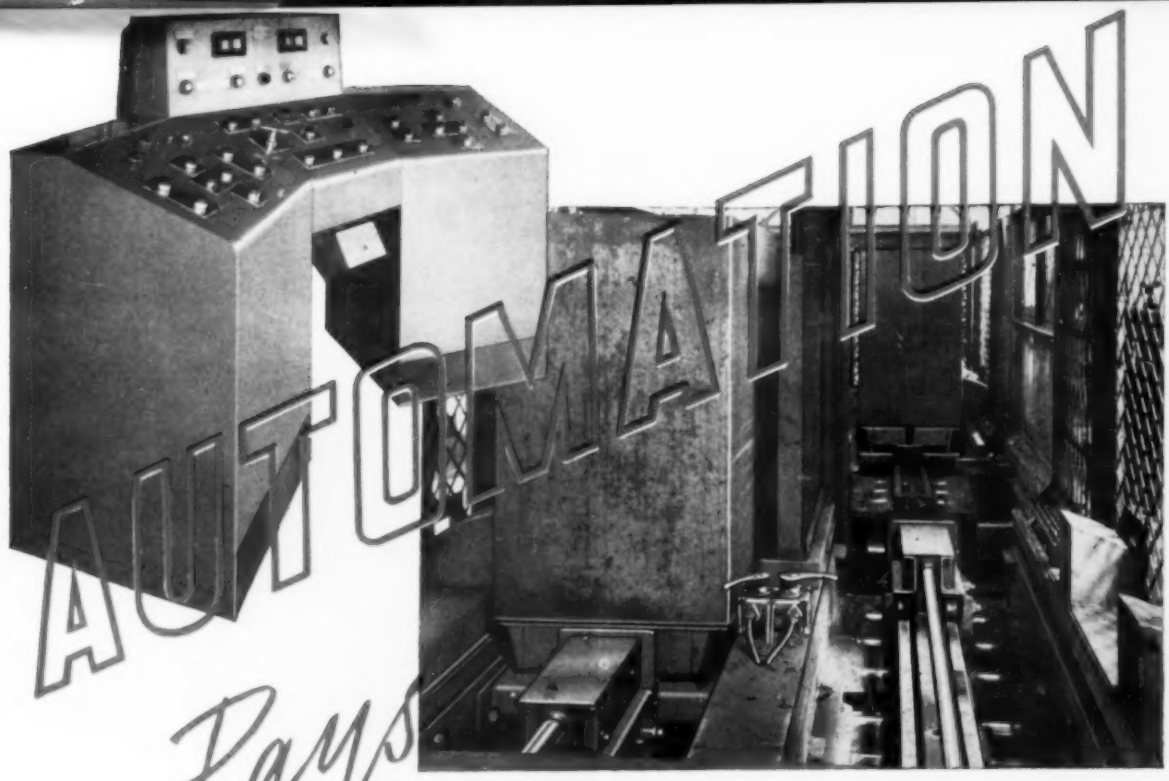
Maximum pump volumetric efficiency is achieved with oil viscosities which keep the combined effects of cavitation and oil slippage at a minimum. Shorter inlet lines and positive feed oil heads allow viscosity to reach a higher level before pump efficiency drops off.

System components: Two factors which are of particular importance at low temperatures because they determine the maximum oil viscosities permissible for efficient operation are:

1. Length and configuration of pump intake pipe.
2. Static head of oil in the feed reservoir relative to pump.

Other design and operational factors which limit the maximum tolerable viscosities for low temper-

Concluded on page 111



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HYDRAULIC POWERED FLYING CONTROLS

Basic design considerations, equipment and methods in use on British military and commercial aircraft are detailed in this two part article. In part 1, design and operation of the Servodyne system and the Fairey Hydrobooster are discussed. Next month, part 2 will describe the Boulton Paul system and the Hobson system.

• By John A. Lankester
European Editor, APPLIED HYDRAULICS Magazine

IN a large number of industrial applications of hydraulic power, travel of the ram is stopped either by its limit of travel or by the manual neutralizing of the selector valve. This is not the case when moving flying control surfaces. These surfaces must respond to any intermediate setting of the master valve, and, having reached the desired position, must remain there until a further movement is imparted at the wish of the controller. This immediate response to an infinitely variable setting, and the holding of the control in any desired position by the automatic neutralizing of the circuit, make such a system differ in design detail from the more common applications. It is also necessary to ensure that manual loads shall be as light as possible to provide for the actuation of the system by means of an automatic pilot. Therefore, the control valves must be sensitive to the smallest movement and friction must be very low. This calls for fine precision engineering and highest quality surface finishes.

A further design consideration is the high importance of reliability and safety factors. Not only is it necessary in the interests of safety that the power system should be duplicated, so that if any component fails a separate and independent circuit takes over automatically, but in some systems it is practicable to ensure safety still further by reverting to manual control in the event of power failure.

The latter requirement calls for declutching of all power actuators from the flight control mechanism to leave it free for manual movement. To ensure instantaneous reversion to manual operation the means of disconnection should be automatic and

virtually infallible. This also applies to changing over from one power circuit to a standby circuit when manual reversion is not incorporated in the design. However, when considering the safety aspect, it is well to remember that every individual component in each circuit probably has in itself a safety factor of 2, and then the whole circuit is duplicated; this, together with reversion to manual control where this feature is possible, provides a safety factor of very reassuring dimensions.

Application of power of one sort or another to assist the movement of the pilot-controlled surfaces of aircraft is not by any means new, but the earlier types of assistance by servo or aerodynamic methods, involving the use of additional servo surfaces, are obviously unsuitable for modern transonic and supersonic aircraft. Hydraulic power-assistance of aircraft controls can be said to have developed in two stages: First, the application of power to assist the pilot's efforts, and second, the complete power actuation of the controls. In the former, there was at all times a mechanical connection between the control column and the controlled surface. In the latter, the movement of the controlled surface is actuated entirely by hydraulic power, frequently through the medium of an irreversible mechanism such as a screw jack. This has resulted in the problem of "feel", since the column solely activating a hydraulic selector gives no feeling of response or sensitivity. A number of British specialist manufacturers make synthetic feel simulator gear to give the pilot the feel of the otherwise "dead" controls.

THE SERVODYNE SYSTEM

One of the best known British systems is the Lockheed Servodyne, made by Automotive Products Ltd. It is adaptable either to power-assisted or fully power operated methods of control.

Figure 1 shows a diagrammatic arrangement of the Servodyne which, for safety, is divided into two duplicated sections. These sections are called primary and secondary. The unit is complete with a changeover valve which admits pressure oil from the emergency alternative source. Another feature is the release valves in both power-pistons to permit whichever is not actually working the control to be moved freely without influencing the operating unit. The method of declutching the idle or inoperative selector valve from the linkage is also shown diagrammatically.

Before studying the hydraulic operation of the Servodyne, its location or installation in relation to the airframe and controls should be examined. With hydraulic cylinders for actuating landing gear or flaps, it is usual to attach the cylinder to the airframe and the ram rod to the moving part. In the case of flight controls, it is more usual to attach the rod to the airframe and the cylinder and control valve to the moving surface. Therefore, in studying Figure 1 it must be remembered that the pistons and rods are the stationary members while the cylinders housing them, together with the selector valves mounted on these cylinders, are the moving parts. The spools of the directional selector valves are, of course, linked to the control column, and a lever in the pilot's compartment actuates the changeover valves for the introduction of alternative power supply. In the piston-heads themselves are the bypass valves, already referred to, which determine which piston takes the load and which remains idle. In the ordinary way, the secondary piston is free to be moved either way because its valve is open as shown on the diagram. In the event of failure of the normal power supply, moving the changeover lever brings the secondary Servodyne into use and the secondary piston bypass closes; at the same time the primary one opens to allow that one to "freewheel".

In this way, it is possible to declutch whichever Servodyne is not under power and obviously it is likewise necessary to declutch whichever directional selector is not in use. This is done, as shown in Figure 1, by incorporating lost-motion links between the pilot's control and the selector spools, so that only when hydraulic pressure is applied to these links are the internal plungers forced apart to the extremities of their travel, thus making in effect a solid member connecting the pilot's control column to the selector spool required. Without pressure between these clutch pistons their housing is free to move over them without imparting its motion to the valve spool.

The hydraulic action is quite simple despite the complications introduced by the duplication and emergency alternatives. The Servodyne acts on the differential area principle having pressure oil permanently piped to the rod end of the cylinder, movement being effected by connecting pressure or exhaust, according to the direction desired, to the blank end of the piston. Difference in areas between the two sides of the piston permits movement to take place. Incidentally the cross-sectional area of the piston-rod is exactly half that of the cylinder bore so that the effective forces are the same in either direction of travel; likewise, since the volume of the piston-rod equals the volume of the annular space surrounding it, the speed of travel is the same in each direction of movement.

Following through the fluid flow on the diagram, the pressure fluid can be traced from the "normal" connection of the left hand changeover valve, together with the fluid from the backing accumulator, to enter the pressure port of the selector valve carried on the Primary Servodyne on the left. Then the oil is admitted at all times to the rod end of the left hand (Primary) Servodyne cylinder whose piston bypass valve is shown in the closed position. When the selector spool is moved to the left, it opens ports connecting the blank side of the piston

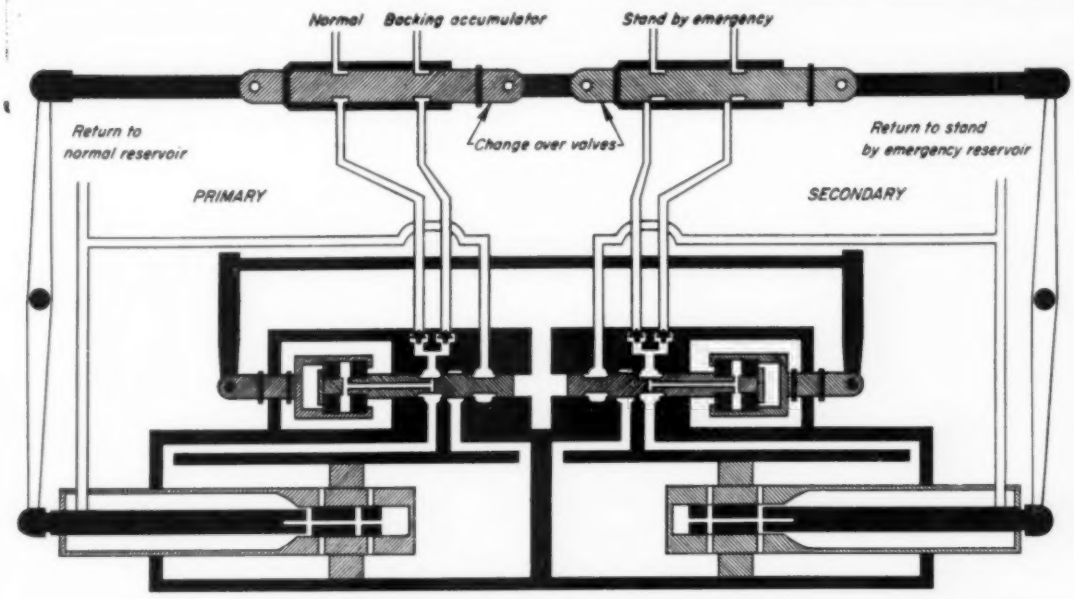

FIG. 1. FOR SAFETY, this Servodyne control has two duplicated sections.

to exhaust line thus freeing the piston to move under the influence of the pressure on its rod side. Moving the selector spool to the right will direct pressure to the blank side of the piston, whose area exceeding that of the rod side, provides the force necessary to move the piston into the extended position relative to its cylinder. It will readily be seen, that, as the cylinder moves, the control valve body moves with it, while the spool remains in the position dictated by the operator, in this case the pilot's control column. Thus the movement of the valve body relative to its spool ultimately restores the selector to its "centered" position, whereupon further movement ceases since the flow of pressure oil is neutralized. Obviously, this applies in whichever direction the motion takes place and the greater the distance the pilot moves the spool, the greater the distance the Servodyne will have to travel before the valve body catches up and restores the "no flow" condition. Thus the movement of the controlled surface is matched to the movement of the pilot's column, however great or small, and in whichever direction, it may be.

Having established the basic sequence, the Secondary and emergency operations can easily be traced out on the diagram: Moving the Changeover lever to the "secondary" position cuts out the Primary Servodyne, both by declutching its control valve spool and by opening the transfer valve in the piston head so that oil can bypass freely from one side to the other freeing this piston to follow the motions of the now-energized Secondary half of the unit.

The operating pressure of this circuit is set at 2,500 psi which it is felt will ensure the highest degree of reliability consistent with lightness, and freedom from the increased shock and fatigue effects attendant upon appreciably higher pressures.

Every hydraulic component in this system has been authorized by the British Air Registration Board to operate for at least 1,000 hours between overhauls, some units having been authorized for as much as 4,000 hours. The system employs natural rubber seals in conjunction with castor base fluid, this arrangement having been found, it is claimed, to give good results at the low temperatures encountered in the installations on aircraft cruising at high altitude. Where the Servodyne is fitted to a four engined aircraft it is customary for one radial piston pump to be driven by each engine; two additional electrically powered pumps provide emergency supplies of pressure fluid.

Total travel of the selector spool is $\frac{1}{8}$th inch which gives maximum rate of cylinder travel but, so sensitive is this valve, that the Servodyne commences to respond at a spool displacement of less than 0.01 inch from the neutral setting.

The hydraulic system powering the Servodyne control circuit follows the well-known pattern using cut-out valves to unload the pumps at their rated pressure and several hydropneumatic accumulators to provide storage of pressure oil to keep the controls live especially when changing over from emergency to power supply. Separate reservoirs are installed for all but one of the Servodyne circuits ensuring an ample supply of fluid and as a safe-

guard against a burst pressure pipe draining the whole system.

THE FAIREY HYDROBOOSTER

Another linear type of hydraulic control, which embodies many of the principles already described, is the Fairey Hydrobooster; single or tandem units are produced which can be installed to give either power-assisted or fully power actuated control respectively. Figure 2, shows the single jack unit, the cylinder assembly being complete with control valve mounted on it. As this unit is designed for reversion to manual control in an emergency, it is not duplicated.

In the Tandem type, however, Figure 3, the cylinder is divided into two compartments, each containing a sliding piston mounted on a coaxial rod common to both. Two servo control selectors are carried on the cylinder, thus providing for duplication for fully power actuated control with comparatively little extra space or weight penalties.

In the single jack model the connection between the ram rod of the Hydrobooster and the flight control anchorage point on the airframe takes the form of a release unit specially designed to disengage the rod in the event of hydraulic power failure, so that it can slide freely without impeding the pilot's manual control. As Figure 2 shows the junction of the tail rod to the anchorage point comprises a pawl which is engaged with a slot on the rod by hydraulic pressure on a spring loaded piston; should the pressure drop to 500 psi the spring can force the piston along its cylinder thus allowing the pawl to disengage the slot. This has the effect of freeing the whole assembly to slide along the rod permitting the pilot to retain control manually without power assistance. The supply of pressure oil to the single jack unit is usually from the aircraft's normal hydraulic system. However, in the case of the tandem unit, where no provision is made for emergency manual movement, it is necessary to have both operating at the same time. In the event of failure of one system then the potential effort of the unit is halved.

The tandem unit, Figure 3, consists of a pair of jacks bolted end to end with a common piston rod. The two selector valves are synchronized to produce a combined effort from each section of the jack. It will be noticed that no provision is made for declutching a selector in the event of failure;

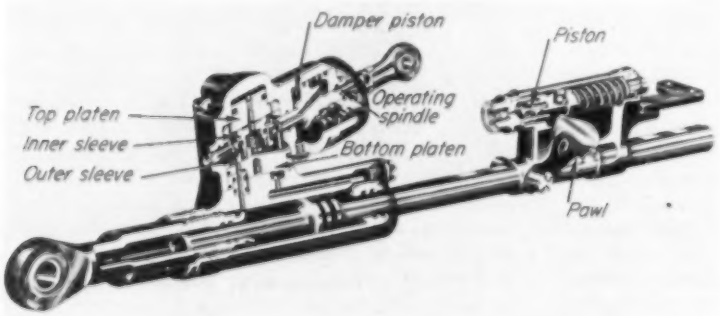

FIG. 2. SINGLE JACK unit, Fairey hydrobooster, is connected to the flight control anchorage point on the airframe with a specially designed release unit which will disengage the rod in the event of hydraulic power failure.

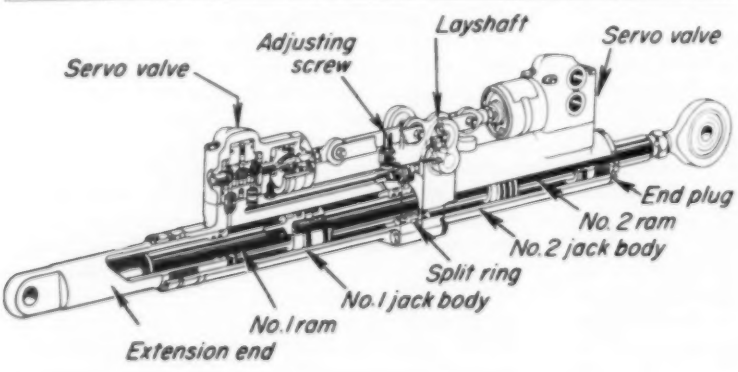

FIG. 3. TANDEM UNIT consists of a pair of jacks bolted end to end with a common piston rod. The two selector valves are synchronized to produce a combined effort from each section.

POSITIVE BRAKING UNDER ALL CONDITIONS

WITH THE NEW Bendix-Pacific HYDRAULIC BRAKE VALVE

Now in use on North American F-100 airplanes, this new Bendix-Pacific Brake Valve (1007069) provides positive braking action under every condition.

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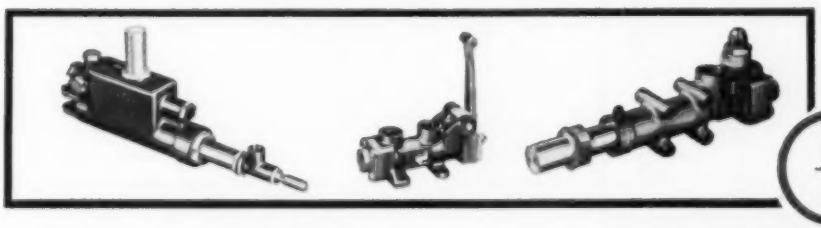
EMERGENCY BRAKE • SLAVE OPERATED • POWER BRAKE AND MASTER BRAKE CYLINDER



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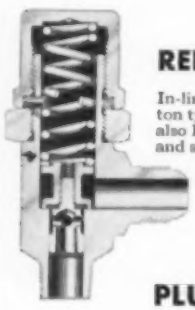

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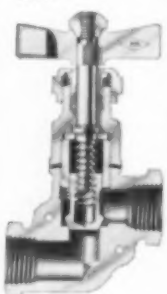
In-line and guided piston type Relief Valves, also Pilot Operated, with quick unloading and silent operation. Metal or rubber seal. 1/8" to 3/4" pipe or tube port connections. Various metals.

PLUG

Precision-made Plug Valves for wide general use in brass, aluminum alloy, or stainless steel, 1/8" to 1", +32° to 160°F. With Teflon plug, −65° to 250°F, without lubrication. Aluminum alloy or stainless steel.



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Super duty shut-off valves, angle and offset, for up to 3000 service, 1/8" to 1". Also high pressure Needle Valves for 10,000 psi. working pressure—proofed at 25,000 psi. One piece, stainless steel, 1/16" to 1/2", Teflon packing.

LO-TORQ SELECTOR

Directional flow control for service up to 6000 psi. Balancing principle uses line pressure to make turning easy with short handle. 2, 3, 4-way, with various drillings. Side, bottom, and sub-plate porting. Panel mounting.

Ask for new catalog, No. 654, showing entire line.

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CHECK RELIEF PLUG GLOBE NEEDLE

RM REPUBLIC MANUFACTURING CO.
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this is because the design of the selector valve is such that seizing is considered practically out of the question.

Hydraulic actuation of both tandem and single units is achieved by directing pressure to whichever side of the piston is required and, at the same time, opening the opposite end to return. This does not involve the use of the differential area principle. For this reason both sides of the piston are of equal area since the piston rod is carried right through to the extension end outside the pressure chamber of the cylinder itself.

Linkage to the pilot's controls follows the normal practice providing for the movement of the ported member of the selector valve by the pilot and the "following up" to restore the neutral position at any desired point being achieved by the movement of the control valve body attached to the moving cylinder which gives the power to move the control surface. In order to provide the pilot with the "feel" of his controls, the unit may be installed so that a percentage of the surface load is fed back to the linkage of the column. This is termed "proportional feed back" and is usually varied to suit the aircraft installation. However for large units this is not possible and artificial "feel" has to be provided.

SHEAR-TYPE SERVO VALVE IS USED

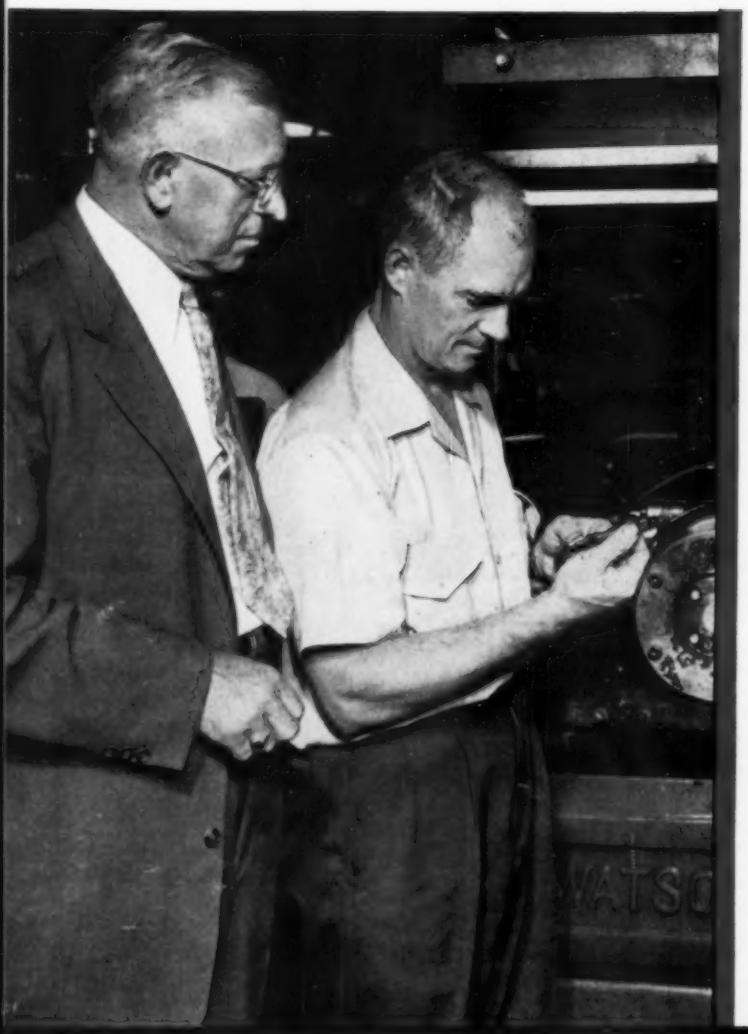
The selector or servo valve used in the Fairey system is of the sliding surface rather than the sliding spool type. An assembly of circular discs is able to slide transversely between circular platens in which ports are drilled through to connect with either end of the jack cylinder. When a pressure port drilled in the fluid control disc coincides with either port leading to the cylinder, the admission of fluid activates the ram in the appropriate direction, at the same time the exhaust oil expelled by its movement returns to tank. The pressure itself keeps the mating surfaces together and prevents leakage across them. A high degree of surface finish is called for to ensure low friction and ease of sliding, particularly important when auto pilots or stabilizers are employed.

It is claimed for this valve design that break-out loads are negligible and it is accepted as a non seizing valve. The ports in the mating surfaces, being circular, provide good flow characteristics. In the initial stages of opening these flows are small, contributing to stability, and in the normal operating positions the characteristics are particularly linear. Overlaps are small and accurately matched between pressure and return ports thus preventing build-up of excessive pressures in the cylinders and reducing phase lag to a minimum. To resist undesirable rapid oscillations in conditions of instability, a damper is included in this design of valve, consisting of a chamber filled with hydraulic fluid containing a piston which moves freely at slow speeds but which resists high speed oscillation.▼▼▼

Circle 78 on Reader Service Card

Circle 86 on Reader Service Card

STANOIL *Industrial Oil delivers on tough assignment at Indianapolis Screw Products Corp.*

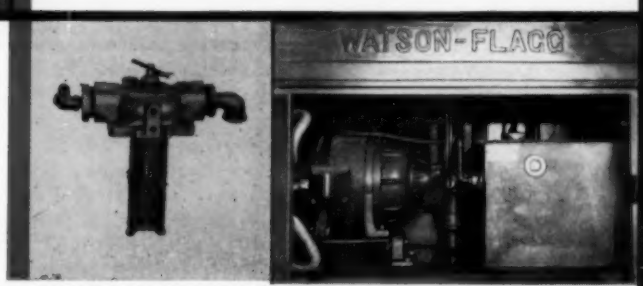


Rolling threads on aluminum bronze with pitch diameter tolerances as close as .0014" is a tough job but Indianapolis Screw Products Corporation is used to taking on such jobs and delivering. They give tough jobs to the hydraulic oil they use, too, and they expect it to deliver. They've given such a job to STANOIL and they're getting the results they expect—and more.

STANOIL Industrial Oil is used in the hydraulic system of a Watson-Flagg precision thread roller in the Indianapolis Screw Products Corporation plant. The system uses a Vickers pump and Cuno filter. The filter has not been cleaned in over a year *because it hasn't needed cleaning.* Here, as in other applications, STANOIL delivers top performance with minimum maintenance and maximum system cleanliness of the hydraulic system.

STANOIL likes tough assignments like this one; likes them because it can deliver with plenty to spare. Perhaps you would like to know about the use of STANOIL in a hydraulic application in your plant. In the Midwest and Rocky Mountain states, a lubrication specialist at your nearby Standard Oil office will be happy to discuss it with you. Call him. Or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Mr. R. W. Williams, Plant Superintendent checks pitch diameter of thread with Glenn Riggs, Standard lubrication specialist. Glenn Riggs is an old hand at helping industrial firms work out lubrication problems. Glenn has been doing this sort of thing for 28 of the 30 years he's been with Standard. This background and experience, customers have found, pay off for them.



Cuno filter (left) remains clean after more than year filtering STANOIL. Vickers pump on Watson-Flagg Thread Roll machine (right). Good housekeeping and STANOIL team to give top performance in this hydraulic system.

STANDARD

STANDARD OIL COMPANY

(Indiana)

Fifth Transport Aircraft Hydraulic Conference

Among the most recent developments in transport aircraft accessory power equipment is the virtual replacement of the turbine drive by the hydraulic alternator, the use of a hydraulic power package and motor for starting high thrust jet engines, a lightweight variable delivery pump and a short life miniaturized pump for expendable applications. One of the features of the Conference was an analysis by a leading airline engineer on the hydraulic causes of flight delay (nearly 70 percent due to leakage), system deficiencies and a suggested program to improve system performance and reliability.

THE fifth Transport Aircraft Hydraulic Conference, sponsored by Vickers, Inc., and held at the Park Shelton Hotel, Detroit, on November 2 and 3 discussed recent developments in transport aircraft hydraulic systems and heard two papers on the future of aircraft hydraulic systems and two on the hydraulic system used in the Viscount aircraft. A fifth short paper by a Vickers engineer on new pump developments completed two days busy agenda for 96 registrants. Participating in the across-the-board discussions were design engineers, maintenance supervisors and service engineers representing 14 domestic and foreign airlines, 19 airframe manufacturers and 12 suppliers of accessory equipment.

Co-chairmen for the conference were N. S. Smith, engineering superintendent, Miami Overhaul Base, Pan American World Airways and A. C. Ford, superintendent of engineering. Delta C & S Airlines.

On the first day variable displacement pumps, constant displacement pumps and motors, seals and accumulators were subjected to lively discussions. Agenda items on pumps included design problems and performance characteristics. Most items were submitted by airline and airframe companies on active and critical problems. The major items on seals were procedures or checks on storage life,

TWO MEN SHARED the chairmanship at the Conference. A. C. Ford, left, superintendent of engineering, Delta C & S Airlines; N. S. Smith, right, engineering superintendent, Miami Overhaul Base, Pan American World Airways.

correction techniques against spiraling of "O" rings (teflon delta and backup rings) and reports of efforts to provide better seals for use with Skydrol. The accumulator items centered around rupture failures of diaphragms, new materials for diaphragms and the desirability of retaining a brake accumulator in new aircraft. Several airline operators reported that they were now specifying cylindrical accumulators.

Two short papers were interspersed with the com-

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PH312E	3"	12"	1-1/8"	1500	" "	"	42.50
PH34I	3"	4"	1-1/8"	1500	Inserted	"	32.50
PH38I	3"	8"	1-1/8"	1500	"	"	35.00
PH45E	4"	5"	1-1/8"	1500	External Threaded	18,750 lbs.	37.50
PH46E	4"	6"	1-1/8"	1500	" "	"	39.50
PH48E	4"	8"	1-1/8"	1500	" "	"	43.50
PH410E	4"	10"	1-1/8"	1500	" "	"	47.50
PH412E	4"	12"	1-1/8"	1500	" "	"	51.50
PH45E3	4"	5"	1-1/2"	3000	" "	37,500 lbs.	52.50
PH46E3	4"	6"	1-1/2"	3000	" "	"	54.50
PH48E3	4"	8"	1-1/2"	3000	" "	"	58.50
PH410E3	4"	10"	1-1/2"	3000	" "	"	62.50
PH412E3	4"	12"	1-1/2"	3000	" "	"	66.50
PH518I	5"	18"	2"	3000	Inserted	59,250 lbs.	85.00
PH524I	5"	24"	2"	3000	"	"	107.50
PH530I	5"	30"	2"	3000	"	"	130.00
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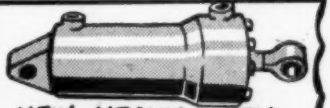
Has built-in adjustable relief valve, set at 1000 PSI with a spring loaded neutral position. Used for controlling (1) double action cylinder of the types shown in this advertisement. Can also be mounted in series. Has 3/4" standard pipe inlet & outlet ports. 1/2" pipe thread cylinder port. Shipping weight 10-1/2 pounds. . . . . **21.50 NEW**



NEW - HEAVY DUTY HYDRAULIC CYLINDER

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GB-8-25 TON HYDRAULIC CYLINDER
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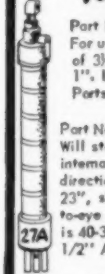
SURPLUS HYD. CYLINDERS

Special

Gov't Surplus Bargain. Produces up to 40,000 lb. thrust with a 3000 PSI line pressure. May also be used as a low pressure air system cylinder. Has a 4" bore, 18" stroke, 30½" length. Part No. 29. New & Used.
NEW **43.95** USED **29.95**



Part No. 27A. Finest Surplus. For use up to 1500 PSI. Has bore of 3½", stroke 21-5/8", shaft 1". Length 29¾". Ports 3/8" AN pipe. **35.77**

Part No. 27B. Similar to above. Will stand up to 2000 PSI. Has internal stroke cushion in both directions. Bore 3-7/8", stroke 23", shaft 1-3/8", eye-to-eye length closed is 40-3/4". Ports are 1/2" AN pipe. **45.00**

Part No. 27C – Similar to 27A above. Take up to 1500 PSI. Has 3-1/2" bore, 23" stroke, 1-1/2" shaft, 34" closed lgth. 1/2" AN pipe ports. **45.00**

HYD. HAND PUMP

12.75

Top condition. Has operating pressure of 1500 PSI. Capacity of 1.5 cu. in. per complete cycle.

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Thrust shaft is in two stages. First stage extends 39" – the second stage extends 18". Each stage works seperately. The overall length eye-to-eye is 61½". Inner shaft is 2-3/4" dia. outer shaft is 3¼" dia. Bore is 4½". Ports are 1/2" AN pipe. **165.00**

COST GOV'T APPROX. $6000
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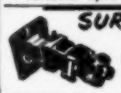
Electric motor driven type. Has a 2500 PSI Hydreco Pump which delivers up to 10 GPM. Powered by 15 HP, 3 phase motor using 220/440 volt, 60 cycle current. Unit has selector valves, pressure gauges, flow meter, reservoir, heat exchanger and filter pressure regulator. Mounted on steel frame. Has work bench, flourescent lights and hand operated, high pressure pump for testing to very high pressures. Overall size: 8ft. long x 7ft. high x 4 ft. deep.

HYD. TEST STAND – Same as above but has a Reeves variable speed reducer to control the pump output as desired. **$18.95**

SURPLUS VICKERS PISTON TYPE-CONSTANT SPEED-HYD. PUMPS & MOTORS



Made to top Aircraft specifications. RPM shown below is the recommended maximum for constant speed. Quantities limited.

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PF9-2713-20ZE	.410	5.3	1500	3000	$24.50	—
PF9-2713-10Z	.208	2.7	1500	3000	$29.75	$22.50
PF2-713-25BCE	.507	6.5	1000	3000	$32.50	$22.50
PF50-3915-30YG	1.520	19.7	3000	3000	—	200.00
HYDRAULIC MOTORS						
MF9-713-15A	.310	4.46	1000	3750	—	$18.50
MF9-713-30BCF	.600	9.75	1000	3750	$37.50	
MF9-713-25BCF	.507	8.25	1000	3750	—	$22.50

STRATO POWER HYDRAULIC PUMPS

Designed and built to finest aircraft specifications.

PART NO.	GPM	PSI	RPM	PRICE EA.
SP-3	2	1400	3750	NEW $27.50
67WF300	3	1500	4500	USED 72.50
67WJ800	8	3000	4500	USED 87.50

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NEW 10 TON HYDRAULIC PRESS

Here is a rugged 10 TON Arbor Press you can use in the shop or take with you on the job. Has sturdy frame of 4" welded channel iron. Press has 4-1/4" stroke, 2-1/2" diameter ram. A control valve operates the piston in both directions. Platform is adjustable. Has positive power Hand Pump. 2000 PSI pressure gauge. NEW **129.00**

NEW SURPLUS VICKERS HYDRAULIC TRANSMISSION

Self-contained, constant torque at all speeds with variable volume, reversible piston pump which supplies hydraulic motor. Has 2 H.P. automatic pressure dash pot for smooth control. Power output RPM is 0 to 1/3 input RPM in both directions. Input RPM 1800 continuous, 4000 intermittent. Ideal for Lathes, Duplicator set-ups, Conveyors, Drives, etc. . . . **44.50**

4" SPLINE SHAFTS for input and power take-off on above. $2.50 pair

INPUT & TAKE-OFF PLATE ASSEM. To adapt trans. to pulley drive. Has high speed bearings and 1/2" keyway shaft. Per Set **20.00**

PESCO HYD. PUMP

A gear type pump. Will deliver 2 GPM at 1500 RPM with 1500 PSI – delivers 6 GPM at 4300 RPM with 1500 PSI. Has .375 cu. in. displacement per rev. Ports are 3/4" standard pipe. 5/8" male spline drive shaft. 4" pad mount. In good condition. **14.95**

NOTE: Items shown here are only a small part of our tremendous stocks. We have over 100,000 Hydraulic Cylinders in 186 sizes and types. Also all type Valves, Pumps, Motors.

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NOW—AN ENTIRELY NEW Bendix-Skinner HYDRAULIC OIL FILTER

Approx. ½ size

OFFERING YOU FINER FILTRATION AT LOWER COST!

Here's everything you've wanted in a filter, including a built-in bypass—and all at a price equivalent to only six quarts of hydraulic oil! Yes, this newest addition to the Bendix-Skinner* line is truly the last word in efficient, yet economical, filtration. Its sturdy aluminum die cast construction assures long service—trouble-free, because it is available with either cleanable "ribbon" type elements for 40-micron filtration, replaceable "pleated" type for 10-micron filtration, or "disc" type, cleanable in 5 or ½ microns. Two ¼-inch N.P.T. inlets and two ¼-inch N.P.T. outlets make installation quick and easy. Operating pressure—100 p.s.i. Complete flow rate-pressure drop data on request.

*TRADE-MARK

ponent discussions. On the first day, K. I. Postel, chief designer-aircraft products, Vickers, Inc., spoke on "Recent Development Related to Commercial Aircraft" and Paul A. Hartline, project engineer-hydraulics, TWA, gave the first of the two papers on design, "Future Aircraft Hydraulics Design as Predicated by Airline Experience".

Mr. Postel detailed recent modifications of the Vickers lightweight variable delivery pump which features an electrically depressurizing control and a new dual range pressure control. He disclosed details of the shortlife design miniaturized pump for expendable applications. He reported that the pump has operated at 9300 rpm and 3000 psi for 6 hours, developing an output of approximately 6 hp per pound. Reporting on high temperature tests to destruction of more than 20 units at inlet and ambient temperature of 550 F, he stated that development emphasis for high temperature hydraulic system operation should be toward seals rather than mechanical design.

Mr. Hartline's paper covered three basic sections: (1) an analysis of hydraulic causes of flight delay and cancellations and of nonroutine maintenance requirements for the hydraulic system; (2) an

CONFERENCE speakers with Vickers representatives. Standing, left to right,: C. H. Merrill, aircraft products sales, Conference manager; (speaker); E. I. Brown, Chief engineer—aircraft products, El Segundo Division (speaker); F. T. Harrington, vice-president-sales; B. W. Badenoch, manager, aircraft products sales. Seated, left to right: R. Hoffmaster, supervisor- manuals and maintenance training, Capital Airlines (speaker); Paul A. Hartline, project engineer-hydraulics, Trans World Airlines, Inc. (speaker); and G. Alesbury, section leader-hydraulic design, Vickers-Armstrongs (Aircraft) Ltd., England, (speaker).

analysis of basic system deficiencies experienced with existing hydraulic systems; and (3) a review of the above findings to determine areas for concentrated effort to improve system performance and reliability. His analysis indicated that leakage caused 68½ percent of flight delays. His analysis of system deficiencies indicated a need for improved detail design of hydraulic components, including non-standard units, the need for coordinating proposed hydraulic systems during early stages of de-

sign. He urged such coordination to include hydraulic designers in the component manufacturing field. He asked that cooperative effort combine the talent of airframe manufacturers, potential aircraft operators and hydraulic system suppliers.

EFFICIENCY OF HYDRAULIC DRIVE

On the second day the open forum discussions covered hydraulic fluids, valves, hose and tubing and miscellaneous subjects. Three technical papers were featured—the second of the two papers on aircraft hydraulics, "A Look at the Future in Aircraft Hydraulics", by Edward I. Brown, chief engineer—aircraft products, El Segundo Division, Vickers, Inc. and the two papers on the Viscount hydraulic system, "The Hydraulic System of the Viscount Type 745" by G. Alesbury, section leader-hydraulic design, Vickers-Armstrongs, Ltd., and "Integration of the Viscount Hydraulic System into Capital Airlines" by R. Hoffmaster, supervisor-manuals and maintenance training, Capital Airlines.

In his paper Mr. Brown compared with other methods the efficiencies of hydraulic power sources for aircraft accessory systems, pointing out for example, that in extracting horsepower from an aircraft engine the hydraulic transmission is probably at least four times as efficient as the turbine drive. He also compared a newly developed hydraulically driven alternator against an inverter which does the same job. The alternator weighs about one-third that of the inverter and has an overall efficiency at least 50 percent greater. Mr. Brown also touched on supercharger drives, jet engine starting devices and accessories and in-flight refueling systems, all hydraulic developments of considerable promise.

3000 PSI VISCOUNT SYSTEM

Mr. Alesbury presented a step-by-step analysis of the Viscount hydraulic system, pointing out features which differ from generally accepted American practice. Two radial piston constant delivery pumps operate the chassis retraction, wheel brakes and steering. Flap operation is electrical. One of the features is the accessibility of the hydraulic components with supply tanks, retraction selector valves, the return line filter and the emergency bypass valve are all installed in a hydraulic cupboard adjacent to the flight deck. The 3000 psi system uses British Specification DTD 585 mineral oil (equivalent to MIL-O-5606).

CAPITAL'S MAINTENANCE RECORD

Mr. Hoffmaster described the success which Capital has had with the Viscount in terms of exceptionally minimal flight delay and out-of-schedule maintenance. He itemized features which particularly appealed to the airline. These are: (1) servicing panel which permits complete servicing to the hydraulic system from a single easily reached point outside the aircraft; (2) landing gear oleos designed for unique two-stage operation; (3) the cylinder type accumulator; (4) the brake units; and (5) the anti-skid brake accessory. ▼▼▼

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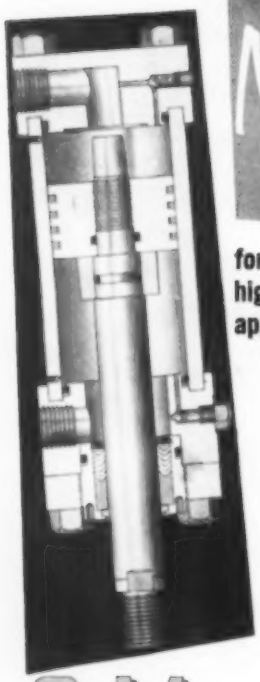

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Ideas from a Sales Engineer

Elmer F. Heiser

Elmer Heiser has been selling air and hydraulic components for 19 years. During this time he has solved many problems and admits to leaving some unsolved. He is the author of the book "Air and Oil Cylinders in Industrial Applications."

Progress?

MUCH has happened in this air and hydraulic business in a relatively few years to change the entire picture.

Take valves for example. Not so many years ago lever and treadle operated valves made up the bulk of our sales. When solenoid operated valves came along, new fields were opened but some definite limits were soon established. All solenoid valves were direct operated. What could be more natural than to take what was already available and convert it for electrical operation by sticking on a solenoid instead of a lever? In the smaller sizes this was reasonably satisfactory, but in the larger sizes trouble developed. A big valve required a big solenoid and it soon was evident that slamming heavy valve parts and solenoid plungers back and forth limited the life of the equipment considerably. Solenoid pilot operated air and hydraulic valves can probably be pointed out as one of the big steps in fluid power progress. Regardless of the size of the main valve or its speed of operation, the actuating solenoid is quite small. Service life has been extended so far that today solenoid valve maintenance is seldom considered a problem.

What development in the fluid power field can compare though with the introduction and general use of sub-plate mounted valves? For many years we went along without realizing that hydraulic valves did not require piping connections projecting from every surface. What plumbing problems to mount six or eight valves on a machine and make no less than four and possibly six pipe connections to each valve? The first problem was where to put the valves so there would be space and clearances to hang the piping, and the next problem was how to start hanging the piping so there would be some space left for the connections which would follow. Wrench clearance to tighten succeeding connections was always a problem and at times an inadvertently bad start could narrow things down to where there was not even space left for some of the last connections to be made. The fore-sighted plumber tried to locate unions close to the valve on each line so the valve could be removed once installed. Such precautions could sometimes be attributed to thoughtfullness and consideration for fellow plumbers who might come into contact with it at a later date. Generally, though, it was done to minimize the work of disconnecting and re-connecting a number of times before the job was finished and running. It was

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APPLIED HYDRAULICS

a foregone conclusion, also, that there would be some leaky joints to take up so the unions served to reduce the effort expended for this purpose.

SHORT-SIGHTED PLUMBERS

The plumber without vision, and with his nose too close to the immediate problem could loop and lace valves into a system so that accessibility for service was by a system of back-tracking. In order to reach the point from which he started it was necessary to start where he finished and undo the maze in reverse order.

The sub-plate valve does not always reduce the first plumber's problem. In the case of one or two valves on a machine he still has the same number of connections to make but they are all on one face of the valve. The major advantage is from the service or maintenance angle, because once installed the connection to the subplate may never be disturbed. A valve can be taken from the system by removing four bolts. A spare can be slipped in place in a matter of minutes.

Without question the advantage of arrangement possibilities available with panel mounted valves rates equally with accessibility for maintenance. Panel mounted equipment has opened new horizons in "packaging" hydraulic components so that complete hydraulic systems can be neatly condensed at one point with all elements easily accessible for checking and servicing.

It has also encouraged the development of manifold installations where valves may be on close centers with one external supply and drain to service a whole group of valves. The surface has only been scratched on manifold usage and perhaps even on their design and construction. Manifolds are pretty much tailored to each job and involve engineering and fabricating costs which often cannot be reconciled with estimate allowances.

It is easy to go overboard on improvements, and this manifolding deal has aroused my enthusiasm. Just about the time though that you figure a new wrinkle answers old problems and has universal application along comes a case which dampens this ardor. Maybe dampen is the wrong way to say it. Let's say it conditions your approach.

PACKAGE ENTHUSIAST

Not too long ago, we were asked to assist in locating the bugs in a new job shipped here from out of town. Whoever designed the system was a package enthusiast—which is okay. As one approached the machine, the pump-reservoir unit was directly in front, and immediately behind it a panel was positioned on which some eight control valves were mounted. From this view you would nod approval and applaud progress in the field. An awful jolt was in store though if you walked past the panel and took a look. All the valves were 1¼ in size, and were mounted on close centers to present a neat balanced appearance from the front. However, there were no less than thirty 1¼ in

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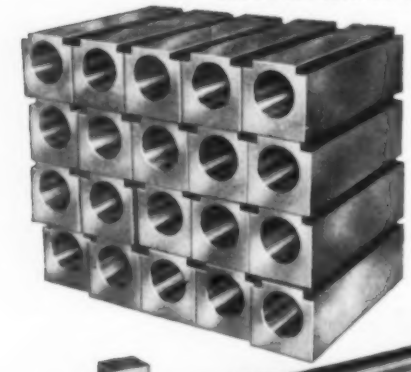

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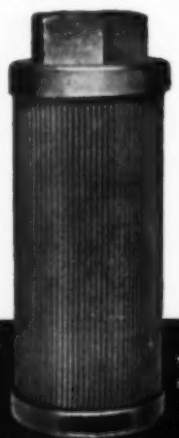

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Ideas From a Sales Engineer

rigid lines sprouting from a relatively small area on the back. These lines spread out like tentacles at an octupus reunion to allow clearance between for numerous shut-off valves, tees, elbows and assorted connections, before rambling over to the machine.

At six paces it would have been a neat trick to throw a rock between the valve panel and the machine without hitting a line.

WHAT, NO MANIFOLD?

Why, you say, couldn't the problem be corrected with a manifold. In this particular case a manifold would not apply as it was necessary to have separate supply and drain connections to the individual control valves with shut-off valves on each line. Due to long unsupported piping runs, the angles, bends, fittings, etc. considerable leakage resulted because of system shocks. So a moat was installed around the whole she-bang to confine the ooze to the area.

The sudden realization that panel valves in packaged units cannot be accepted as a universal answer for hydraulic systems was a let-down. Obviously there are limitations to condensed packaging.

BACK TO THE OLD WAY

Second guessing the package-minded designer on this particular job, it was very easy to see that the control valves should not be in a neat cluster on a panel, but scattered on the machine. This would have greatly simplified the piping with only a pressure and drain loop around the base of the machine. Each valve could have been reduced by a sizable percentage and all of it could have been rigidly anchored. Instead of the present throbbing, jolting, grackles nest, the simple loops of piping would go unnoticed on the relatively large machine.

There it is again, second guessing, after the other guy stuck his neck out. Apparently the problem with progress is temperance, but how do we foresee such things and pull up on the reins when progress ain't progressive no more? ▼▼▼

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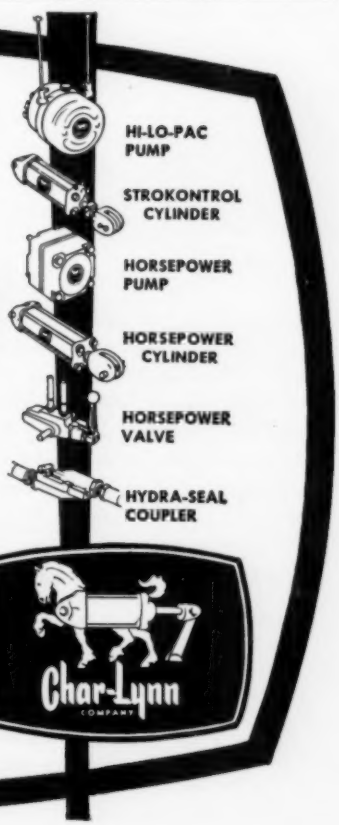
Operation of the Hydra-Seal Coupler is as simple as inserting or removing a plug from an electrical outlet. To couple, hook on and push together; to uncouple, pull apart; no tools are needed. As the barrels are hooked over the slide lugs and the coupler pushed together, the barrels displace the slides and the barrel ports are brought into register or alignment . . . thus allowing the free flow of fluid through the coupler. Pulling the coupler apart brings the slides into position over the ports—oil is sealed in, dirt sealed out.

Let Char-Lynn solve your coupler problems.



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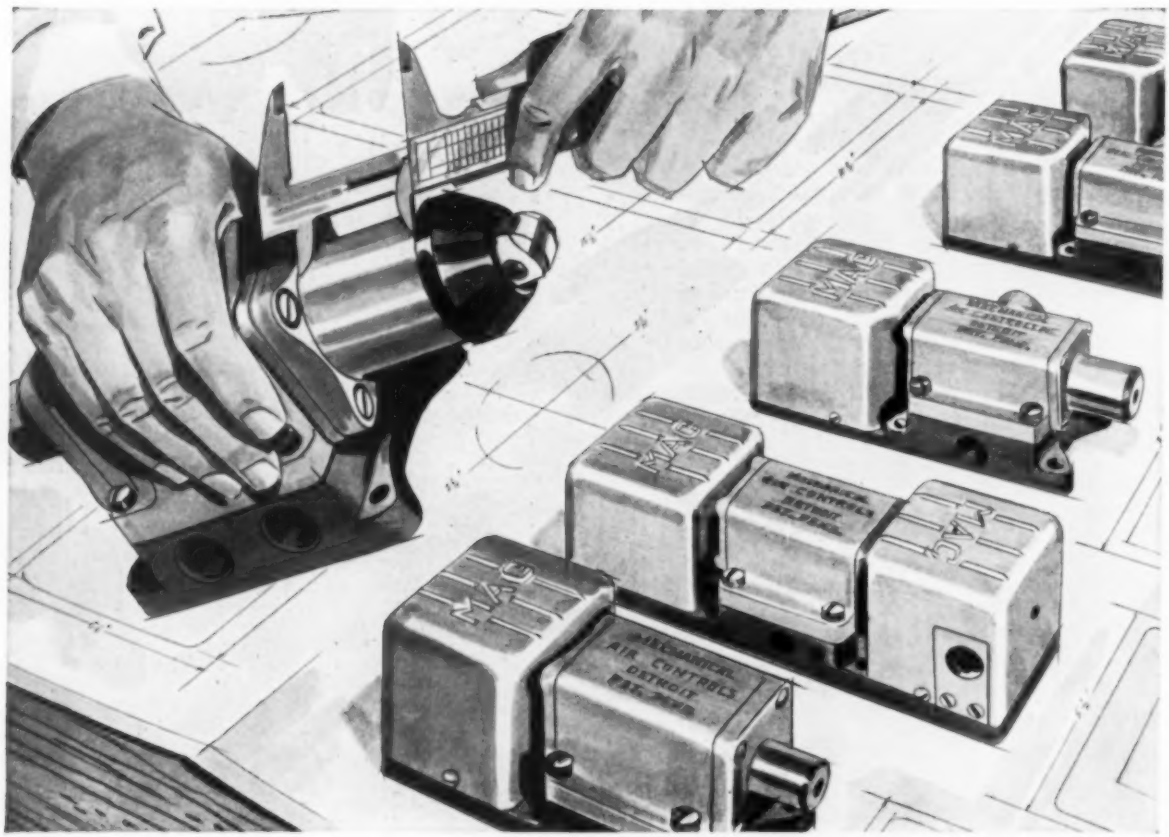

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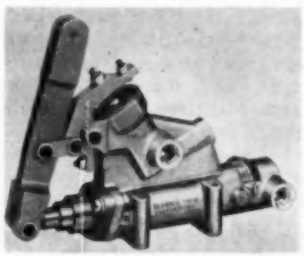

Where main system pressure is not available, a master brake cylinder has been incorporated. Both the master brake valve and the power cylinder are unaffected with the use of anti-skid equipment in the brake system.

Gladden Products Corp.
Glendale, Calif.

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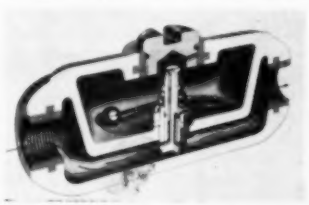
AIR LINE LUBRICATOR

. . . operates in any position

Designation: Oil-IR

Features: Lubricator operates on pressure differential created by air flow, and works equally well on constant or pulsating air pressure. Automatic pressure equalization prevents loss of lubricant when pressure is suddenly reduced or shut off. Quantity or oil feed can be ad-



justed as required by a simple and easily accessible metering valve. Filling is through a large opening and does not require shutting down the tool.

Specifications: Fixed lubricators are available in 1, 2, and 12-quart sizes. A valve type lubricator is also available for manifold installations to handle a number of units from one main oil supply tank.

Ingersoll-Rand
New York, N. Y.

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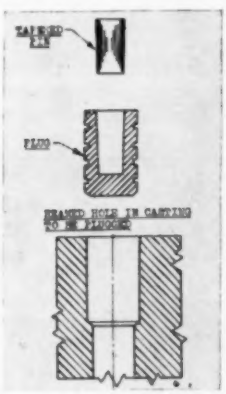
PIN PLUGS

. . . form tight seals

Features: These plugs provide efficient seals for holes that have been drilled in the manufacture of pneumatic and hydraulic equipment for use as flow or pressure passages. It is a cylindrical plug with tapered, reamed hole in center, expanded mechanically by a pin after the pin plug has been inserted. When driving in tapered pin until exposed ends are flush, there will



result an interefrence fit of .0020 inches. Numerous small grooves on O.D. of pin plug will each form own seal and retaining ring.

The Lee Company
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DRILL FEED

. . . to convert drill press

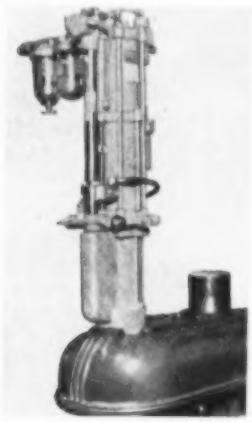
Features: Drill feed permits production automatic drilling, tapping, reaming, threading, counterboring, spinning, spot-facing, fly-cutting and many other operations. Work cycle of air-operated and hydraulically controlled drill feed is started by foot pedal. Three control knobs adjust all precision operations. Fast approach is from 0 to 4 inches; drilling depth is controlled by a micrometer type dial to an accu-

Continued on next page

New Products continued

racy of ± .002 inch. Dial-set feed valve adjusts drilling speed to any material hardness.

Design: Feed has no gears and no resulting slack to impair accurate drilling. It does not interfere with



manual operation of drill press. No electrical devices are used, so that the unit is safe near volatile material. Instant hand and foot pedal release are dual safety features.

General-Pacific Corp.
Culver City, Calif.
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SYNTHETIC MATERIAL
. . . for strength and resiliency

Designation: Disogrin

Features: Material was developed for use in hydraulic and related fields and has outstanding properties of tensile strength, abrasion resistance, aging, and oil and fuel resistance. Material is flame-retardant and may be bonded to metals by special processes. Parts fabricated from the material may be reinforced with fabric.

Applications: Typical uses are for accumulator bladders, O-rings, bellows, diaphragms, check valve buttons, valve seals, tubing, and gears.

Greer Industries, Inc.
Jamaica, N. Y.
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LIGHTWEIGHT SOLENOID VALVE
. . . for 3000-psi aircraft service

Designation: Series 7300

Features: Four-way, pilot-operated valves feature low current drain, low leakage, and positive actuation. Entire unit is constructed

from corrosion resistant materials. Solenoids operate in the range of 18 to 30 volts.

Design: Valves are available with or without manual override, 3-position spring centered, 2-position spring offset, 3-position detent, with thermal relief, and with special spool and sleeve combinations. A simple, trouble-free ball poppet is employed in the pilot valve section. The main valve section is designed to provide low pressure drops and positive valve actuation even at low system pressures. Unit

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F.O.B. Wilmington, Ohio.
MODEL BVP1—Single Solenoid less exhaust controls.

*⅛" to 1" sizes, single and double solenoid. High speed • Accurate control • Compact • Low current demand • Write for detailed information.

Look to Beckett for advanced design! A complete line—150 models—of air and hydraulic directional control valves *. . . precision-built, economically priced!* Send for catalog.

BECKETT-HARCUM CO., INC.
1086 WAYNE ROAD, WILMINGTON, OHIO
See HI-CYCLIC VALVES, Booth 545, ASTE Show

Circle 15 on Reader Service Card

is provided with AND-10050-4, -6, -8 ports for ¼, ⅜, ½-inch tube sizes.

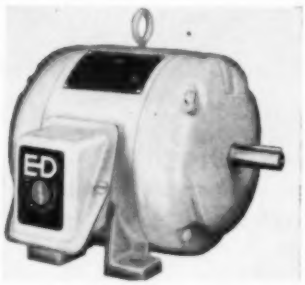
Aircraft Products Co.
Bridgeport, Pa.
Circle 118 on Reader Service Card

ELECTRIC MOTORS

. . . rerated to NEMA standards

Designation: Type H

Features: More compact than previous types, these units provide the same horsepower in less space and reduced weights. Included in the new design features is a low air opening in the end-bell which protects the winding from liquids and abrasive dust.



Specifications: Currently standard ratings are available in frame sizes 182, 184, 213, 215, 254U and 256U. Balance of the rerated NEMA line will extend to 40 hp 3600 rpm.

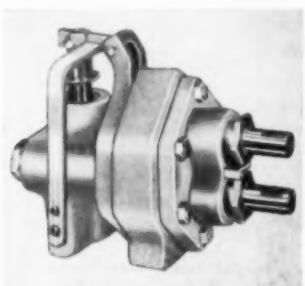
Electro Dynamic Motor and Generator Division
General Dynamics Corporation
Bayonne, New Jersey
Circle 119 on Reader Service Card

VALVE AND PUMP UNIT

. . . for material handling equipment

Designation: SL Series

Features: Spool type 3-way valve and pump are designed for use with single acting cylinders. The power package has a built-in adjustable



pressure relief valve. The spool type balanced valve can be operated by cable or lever control for raise, hold or lower positions.

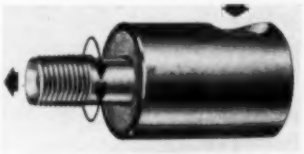
Specifications: Available in 5 sizes, from 8 gpm to 22 gpm at 1000 rpm, 1000 psi. Single or double shaft models to fit any rotation of power take off. Frictionless shaft sealed models available for continuous operation.

Wisconsin Hydraulics, Inc.
Milwaukee, Wis.
Circle 120 on Reader Service Card

SWIVEL JOINTS

. . . single plane type

Application: Designed especially for hydraulic or pneumatic service on pipe, tubing, or hose joints provide for 360 degrees turning or rotating motion. Units can be used as connectors for hose reducing hose



length by eliminating sharp bends and increasing hose life by relieving all twisting stresses.

Continued on next page

Why "Superior" (SAE) hydraulic tubing practically eliminates failure in critical hydraulic systems

The production of Superior (SAE) Hydraulic Tubing is carefully controlled from the melting of the steel to the final testing of the finished tube. The steel used is a non-aging type. It will not age harden in storage racks. Carbon content is held to 0.12% maximum (JIC Standards permit 0.18% and SAE Specifications 0.15%).

Mechanical properties more closely approach those of copper than any other steel products. Elongation, for instance, is 35% min. in 2" for tubes of ⅜" x .035" wall and over. This means that the tubing is easily hand bent and flared.

A clean, bright OD-ID finish is the natural result of the cold drawing and bright annealing practice standard at SUPERIOR, and the ends, both outside and in, are deburred. Furthermore, all tubing is thoroughly tested, as the pictures on the right show. Such quality practices give SUPERIOR tubing a tremendous advantage over annealed mechanical or pressure tubing—make it practically troublefree.

The selection of the proper tubing for your application depends on three factors: pressure, velocity and flow. Write for Superior Hydraulic literature. It lists recommended working pressures for Superior (SAE) Hydraulic Tubing and gives you the velocity and flow information needed to calculate the proper ID for tubing used in your equipment. Use the coupon.

TUBING MUST FLARE without difficulty and without forming minute surface notches or breaks. Each order of Superior (SAE) Hydraulic Tubing is tested for flareability.

EVERY SINGLE LENGTH of Superior (SAE) Hydraulic Tubing is 100% hydrostatic tested.

SUPERIOR TUBE COMPANY
2030 Germantown Ave., Norristown, Pa.

☐ Send me free Superior (SAE) Hydraulic literature.

☐ Send me a free sample of hydraulic tubing _____" OD and _____" wall to be used for _____

☐ Send the name and address of the distributor nearest me.

Name.....
Title.....
Company.....
Street.....
City.....Zone.....State.....

New Products continued

Design: Swivel joints are produced in ball bearing and thrust bearing types for pressures to 2000 psi depending on size of joint. Temperature ratings are —20 F to 225 F and joints are equipped with O-ring seals and have low rotating torque at all pressures. Bearings are sealed and require no lubrication maintenance. Standard sizes are ¼, ½, ⅜, and ¾ inch.

Barco Manufacturing Co.
Barrington, Illinois

Circle 121 on Reader Service Card

COLLET CLOSER

. . . is air powered

Designation: Model BCC-60

Design: Unit consists basically of a hollow draw bar mounted through the center of an air cylinder. The machine collet is fastened to the draw bar, is opened and closed by operating the air cylinder, which is a nonrotating type and exerts a closing pressure equal to 25 times the air pressure applied.

Features: Collets may be opened and closed instantly without stopping the machine. Holding pressures do not vary from piece to piece. Variations on stock size do not affect the action. The unit may be pushbutton controlled by the operator or interlocked with the machine cycle for fully automatic operation.

The Bellows Company
Akron, Ohio

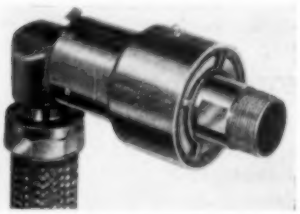
Circle 122 on Reader Service Card

ROTARY JOINTS

. . . with two ball bearings

Designation: Type PR 25

Design: In addition to standard features of exterior screw adjustment, floating rotary seal, and pressure equalizing chamber, joint is equipped with two ball bearings to support and axially guide revolving shaft. This prevents misalignment



and wobbling of the shaft assuring continuous leakproof performance. Unit is provided with a tamperproof metal seal. Line of joints is available in standard sizes from ⅜ to 2 inches in both syphon and single-flow types.

Seamlex Co., Inc.
Long Island City, N. Y.

Circle 123 on Reader Service Card

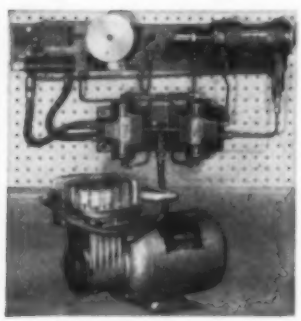
PRESSURE INDICATING INSTRUMENT

. . . uses crystal transducer

Features: Instrument consists of quartz crystal pressure gage and calibration unit to match high impedance of the pressure gage to the input impedance of any d-c oscillo-

Modernair

SERIES J AIR COMPRESSOR



Portable Air Supply for Powering Pneumatic Equipment

Delivers 3.2 cfm air, pressures to 100 psi, for powering air controls and equipment, instrument air supply, etc., wherever piped air is unavailable. Air is oil-free; unit never needs lubrication. Heavy-duty ⅓ hp. 115/230 v. motor with capacitor, overload protection, 8 ft. cord. Weighs only 40 lbs. No tank, no safety valve required. Write *now* for free literature.

Modernair CORPORATION

Dept. B-2, 400 PREDA ST., SAN LEANDRO, CALIF.
Member National Fluid Power Association 12

Circle 66 on Reader Service Card

4 pounds of information FREE to YOU . . .

. . . 400 pages of detailed information on Vogt drop forged steel valves, fittings and flanges

Here's a reference book chock full of useful information about Vogt Valves, Fittings and Flanges; famously noted for maximum safety, proved performance, and unmatched service life in piping installations of every kind. You'll find designs and types for every high or low pressure and temperature requirement for steam, water, oil or gas services. A Refrigeration Section is included.

Send for your FREE copy of Catalog F-9 today. Address Dept. 24-FAH.

HENRY VOGT MACHINE CO.

P. O. BOX 1918 LOUISVILLE 1, KENTUCKY

Circle 99 on Reader Service Card

scope, thus providing accurate pressure calibration. Static pressures and pressure variations can be displayed on the screen of an oscilloscope or other recording device.

Design: Pressure gage has composite diaphragm of soft corrugated iconel ring and small wedge-shaped steel pieces that bridge gap between housing and inner element and support soft diaphragm. Same gage is used to measure all pressures from less than 0.1 psi to

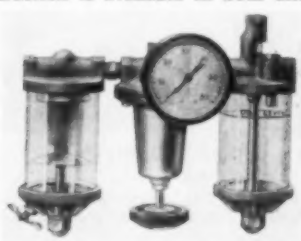
greater than 3000 psi. With high pressure adapter range can be extended to above 20,000 psi. Pressure indicator offers many advantages over more conventional strain gage, capacitance, and inductive type pressure pickups, and other crystal type pressure transducers.

Kistler Instrument Co.
N. Tonawanda, N. Y.

Circle 124 on Reader Service Card

AIR REGULATORS
. . . filters, lubricators

Features: Filters and lubricators have a transparent bowl for air pressures up to 150 psi and temperature to 120 F. Metal bowl construction is available in both units



for operation at 250 F. Available with ¼-inch NPT female connections with larger sizes under development. Combination units including, filter, regulator, and lubricator have 160-psi pressure gage, except for combinations having special regulator.

Watts Regulator Co.
Lawrence, Mass.

Circle 125 on Reader Service Card

Continued on next page

How to Engineer
Dependability into
Your Hydraulic
System....
Specify Gerotor
Hydraulic Pumps
Years of trouble-free operation
are yours with the GEROTOR line of precision-manufactured hydraulic pumps. The unique GEROTOR principle . . . heart of every GEROTOR pump . . . is so designed that friction is reduced to a minimum.
GEROTOR HYDRAULIC PUMPS, designed into your hydraulic systems, assure lower maintenance costs over longer life. Standard GEROTOR pumps are available in capacities ranging from .4 g.p.m. to 40 g.p.m.
Due to modern production facilities, GEROTOR can produce special pump designs in quantities on an economical basis. Whatever your hydraulic pump problems, bring them to GEROTOR.
FREE literature available . . . write:
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MAY CORPORATION
MANUFACTURERS OF—
1535 MARYLAND AVENUE, BALTIMORE 3, MARYLAND
Hydraulic Pumps and Motors
Variable Speed Hydraulic Transmissions
PneuBin—Pneumatic Bin Evacuators

Circle 42 on Reader Service Card

New Products continued

NEEDLE VALVE

. . . of 416 stainless steel

Construction: Valve is made entirely of 416 stainless steel for corrosive service. It is suitable for pressures to 10,000 psi. The valve stem

is precision machined with fine pitch threads for exceptionally fine regulation. Deep chambered threads are machined to extra long length permitting under-sized pipe threads to make up tightly. Also the possibility of restricted flow due to pipe ends coming too close to inlet and outlet ports is entirely eliminated. The packing is tailor made to fit extra deep packing space and is exceptionally clean and easy to remove and install.

Jas. P. Marsh Corp.
Skokie, Illinois

Circle 126 on Reader Service Card

LIMIT SWITCHES

. . . are watertight

Construction: Watertight switches of NEMA types 1-A, 2, 4, and 5 withstand water, dust, and oil conditions even under severe operating conditions. An O-ring shaft seal, captive cover screws, watertight switch cover, and six back cover screws ensure positive seal. A glass fiber arc shield is fifteen times more arc resistant than other types.

Design: Switches permit 70 degrees safety overtravel without use of extra springs or cams. Interchangeability of mountings and levers permits installation in most applications. Switches are available in

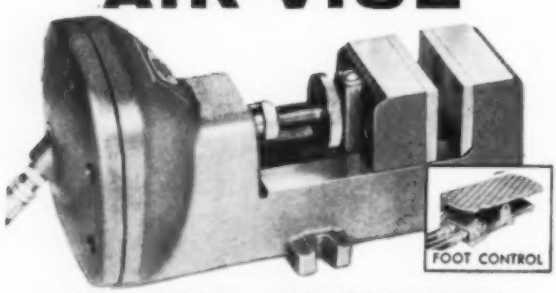
double break models for double-pole, single-throw; three-pole; neutral position, double-throw, normally open and normally closed. All models have isolated circuits.

R. B. Denison Mfg. Co.
Cleveland, Ohio

Circle 127 on Reader Service Card

Continued on page 96

Speedy
AIR VISE



HIGH SPEED · POWERFUL GRIP

New, improved model speeds up all repeat operations—*milling, drilling, tapping, punching, bending, riveting.* Both hands left free to produce more! Light squeeze to 2250 pounds pressure! Extra thick jaws for attaching jigs. Jaws open to 3-inches; 1/16" to 5/8" maximum travel. Complete with foot control, air hose and fittings..... **$44.00**

SPEEDY 1-TON AIR PRESS

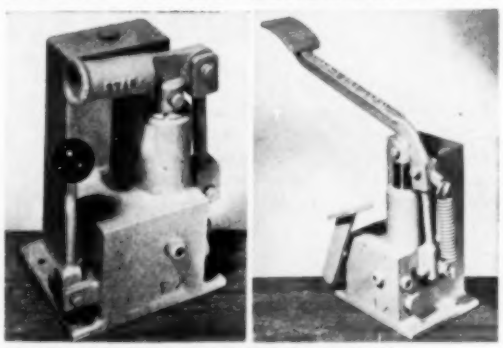
Does the work of expensive presses! Power factor 15 times air line pressure. 5-inch throat; Ram 0 to 5"; stroke ⅜"; table 5" x 5". Operated by foot or fingertip controls. **$85.00**

Order from Your Supplier or Write for Air Tool Catalog

W. R. BROWN CORP., 2655 N. Normandy Ave., Chicago 35

AIR TOOLS • AIR VISES • AIR REGULATORS • FILTERS • COMPRESSORS

STAR Hi-Lo TWO SPEED CONCENTRIC PUMPS



HAND OR FOOT OPERATED WITH SINGLE LEVER OR PEDAL

Two speed construction provides automatic change-over during operating cycle from high speed low pressure to low speed high pressure.

MAXIMUM CAPACITY 10,000 P.S.I.

Safety overload valves—Hard chrome plated pistons—Piston stroke 1½ inch—Oil capacity 150 cu in or larger—5 models: (½"-⅞"), (½"-1¼"), (½"-1½"), (⅝"-1½"), (½"-2¼").

Special engineering counsel and proposals cheerfully submitted on request. Ask for Catalog #555.

Representative areas available

STAR JACK CO., INC.
420 LEXINGTON AVENUE, NEW YORK 17
PLANT: RIVER GROVE, ILLINOIS

Circle 20 on Reader Service Card

Circle 88 on Reader Service Card

You Can't See a Crippled Heart

She doesn't use crutches, and, except for a drawn and listless expression, looks very much like any other little girl. But she is crippled. She has a crippled heart—the kind of disability you can't see.

And it may surprise you to learn that the tragedy of congenital heart disease affects more than 500,000 children of school age in the United States. For them, as for people of all ages, heart disease is a leading health problem.

Fortunately, medical research has scored dramatic victories in prevention, care and treatment of the heart disorders of young people. Some congenital heart defects, for example, now yield to surgical correction. Both initial and recurrent attacks of rheumatic fever, forerunner of rheumatic heart disease, now may be prevented in most cases.

But more research is needed if young hearts are to be saved—the kind of research supported by the Heart Fund. Indeed, the chances of many thousands of children for a full, rich and happy life depend on this research.

HELP YOUR HEART FUND — HELP YOUR HEART

Send your 1956 Heart Fund contribution directly to your local Heart Association, or to "H-E-A-R-T," care of post office.

KEEP AIRCRAFT HYDRAULIC CIRCUITS CLEAN

FERROFILTER

Magnetic Separators

protect fluid power systems of aircraft by removing microscopic ferrous particles that can jam delicate hydraulic equipment. Dry weight only 3 lbs.; 3000 psi working pressure; tapped for ½" tube connection—AND-10050.

the "works"

Liquid flows through stack of grids (left) magnetized by two powerful Alnico permanent magnets (one shown). The "honeycomb" design splits the fluid stream and fine ferrous particles are caught on the grid edges.

Send for Bulletin 65-A

High pressure industrial models also available.

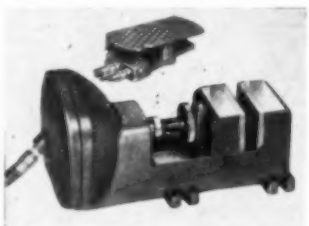
S. G. FRANTZ CO., Inc.

Brunswick Pike and Kline Ave.
P. O. Box 1138 Trenton 6, N. J.

New Products continued

AIR VISE
. . . controlled force

Features: Gripping force can be controlled from light squeeze to 15 times air line pressure or a maximum of 2250 lbs. Extra thick steel jaws are soft enough to be milled



for holding jigs, fixtures, and drill bushings. Jaws open to 3-inches with maximum travel up to ⅝ inch. Ram is driven by a multiple-ply diaphragm that eliminates air leakage, slippage, and lubrication. Hold down lugs are provided and unit comes complete with air hose, foot control valve, and fittings.

W. R. Brown Corp.
Chicago, Illinois
Circle 128 on Reader Service Card

SWIVEL JOINT
. . . 4000-psi aircraft use

Features: Precision-made coupling under 4000-psi pressure permits shaft to rotate with a maximum of 8 lb.-in. torque. External configuration of both body and rotating shaft may be tailored to fit particular system. Compactness and weight saving may be achieved by disposing of the body and have the cylinder or other component incorporate the necessary dimensions to

take the rotating shaft and other parts of the joint.

Performance: Original design was tested for reliability at 4000 psi, but subsequent testing has proved the coupling at static and impulsing pressures to 6000 psi over a temperature range from —50 degrees C to +80 degrees C. Pressure drop across joint makes it suitable for service with air, hydraulic fluid or fuel at an operating pressure of only 50 psi over a temperature range from —62 degrees C to +70 degrees C. Present testing is evaluating swivel joints for use with non-flammable fluids.

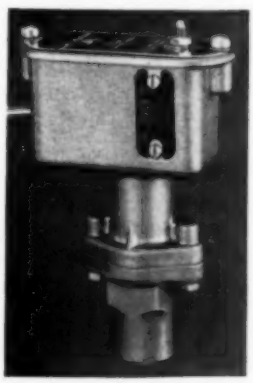
Avica Equipment Ltd.
London, England
Circle 129 on Reader Service Card

PRESSURE SWITCH
. . . set without gages

Designation: C9612

Design: Switch has a calibrated plate for visually setting unit before or after installation. Tamperproof indicator inside the switch is visible through a window in the plate.

Features: Switch accurately senses any system pressure over an adjustable range of 15 to 3000 psi; the



particular range may be covered by one of four classes of switch. Fixed actuation valve varies from 10 to 250 psi depending on switch setting. Piston type sensing element will perform millions of cycles under fast continuous operation, and is not sensitive to jarring or vibration. Mounting bracket may be rotated to any position on a full circle or moved up and down on the neck of the switch.

Barksdale Valves
Los Angeles, Calif.
Circle 130 on Reader Service Card

PLASTIC CAP
. . . for AN and SAE fittings

Design: Polyethylene, transparent cap is for protection of fittings

Continued on page 98

New ASCO 3-Way Solenoid Valve assures MILLIONS OF TROUBLE-FREE OPERATIONS

NO EQUAL IN SIMPLICITY!

Simplicity is the secret of this remarkable, new 3-way diaphragm valve.
It has *only three operating parts.*
Compare this with the larger number of parts found in conventional 3-ways! That's one reason why the new ASCO valve means trouble-free operation . . . substantial savings in maintenance costs . . . reduction in down-time losses.

SIMPLICITY IN OPERATION

Not only its construction but also its new operating principle is the essence of simplicity: solenoid piloting of two simple diaphragms.

UP TO 400 CYCLES PER MINUTE

Exceptionally large flow capacity makes rapid recycling feasible . . . cylinders fill and vent rapidly . . . valve operates up to 400 cycles per minute over millions of strokes.

CONVERTS IN 30 SECONDS

Developed for dependable control of liquids and gases, the valve can be converted from normally open to normally closed or the reverse by simple rotation of the valve bonnet.

This new valve is absolutely tight seating . . . no closely fitted parts or valve seat grinding required. Available now in ⅜" and ½" pipe sizes, both with full ⅜" orifices, it can be mounted in any position.

WRITE NOW for your copy of ASCO Bulletin 8316, or have the ASCO Engineer call.

The EXTRA HEAVY FORGED BRASS BODY houses only three moving parts: Two diaphragms and a core. Corrosion protection is assured. All parts in contact with fluids or gases are brass, stainless steel or Buna-N.

ASCO®

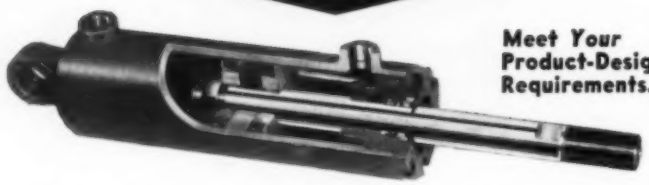
DEPENDABLE CONTROL

AUTOMATIC SWITCH COMPANY • 385H LAKESIDE AVENUE • ORANGE, NEW JERSEY

AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL

Circle 19 on Reader Service Card

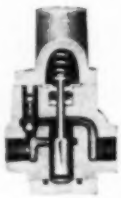
HYDRAULIC CYLINDERS
CUSTOM-DESIGNED
by **B.H.E.W.**



Meet Your Product-Design Requirements.

Dependable performance in minimum mounting space is characteristic of B H E W hydraulic cylinders. Standard and special O.E.M. designs of all types, sizes and any mounting style are available on order . . . delivered on schedule.

Send specifications of your requirements for ANY kind of hydraulic, pneumatic and water cylinder.

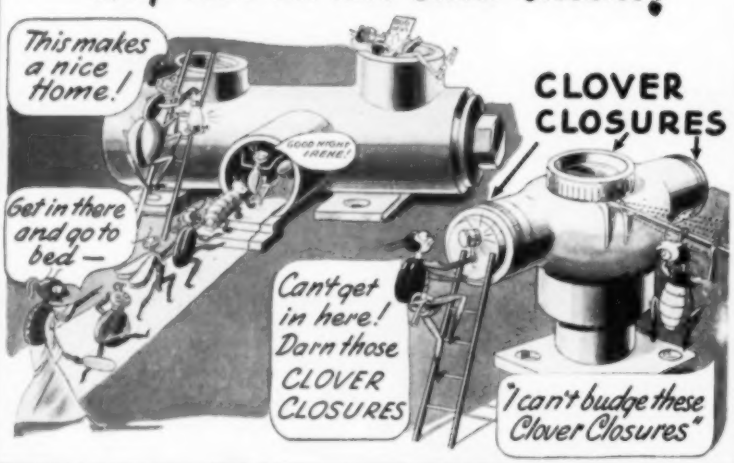


BHEW

Lift trucks need the B H E W Pressure-Operated Hydraulic Flow Control Valve. It eliminates surge as load starts down. Load-weight controls rate of descent.

Benton Harbor Engineering Works, Inc.
St. Joseph, Michigan

You've taken the bugs out of your product—
Keep them out with Clover Closures!


This makes a nice Home!
CLOVER CLOSURES
Get in there and go to bed—
Can't get in here! Darn those CLOVER CLOSURES
"I can't budge these Clover Closures"

METAL

PLASTIC

METAL

Metal or Plastic Immediate Delivery
Clover Closures protect your product from dust, dirt, moisture and thread damage. Write for free samples and literature.

Clover Industries, Inc. 583 YOUNG STREET TONAWANDA, N.Y.

New Products / continued

during shipment and storage. Self-sealing tapered ring is molded on inside of cap to fit inside diameter of the fitting making a tight inner seal. Corner of cap is square providing a cushioning effect and protecting the flare face of the fitting. Side wall of the cap is slightly tapered and sized to make a push fit

against threads of the fitting. Bottom flanged edge resists stretching ensuring a tight fit indefinitely.

Specifications: Plastic material is tough, flexible, non-corrosive, and impervious to all common chemicals and oils. Caps are for fittings with course or fine threads in sizes from 5/16 to 1-1/16 inch. Caps fit similar range of tubing sizes.

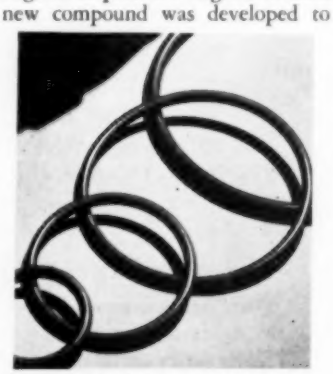
Plastic Div.
Clover Industries
Tonawanda, N. Y.

Circle 131 on Reader Service Card

O-RINGS

. . . for greater temperature range

Features: Made from new synthetic rubber compound No. 47-671, these O-rings will operate in a temperature range of minus 65 degrees to plus 275 degrees F. This new compound was developed to



meet the rigid functional and physical requirements such as those included in Government specification MIL-P-18017.

Applications: For aircraft hydraulic service.

Parker Appliance Company
Rubber Products Division
Cleveland, Ohio

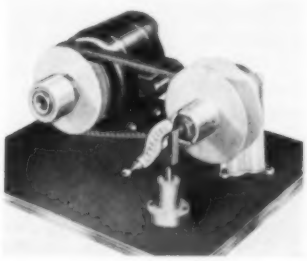
Circle 132 on Reader Service Card

VARIABLE SPEED PULLEY

. . . keeps constant alignment

Performance: Compound drive pulley provides constant belt alignment through entire speed range up to 8 to 1. With a 1750-rpm motor, a speed range of 5550 to 690 rpm is obtained at a rated ¾ hp. With an 1150-rpm motor a speed range of 3650 to 454 rpm is obtained at a rated ½ hp.

Design: Pulley accommodates new NEMA motor frame shaft sizes and uses a ⅞-inch top width or "A" belt. Available in either spring loaded or manually operated design, it



can be mounted on one side or alternate sides in accordance with installation requirements. Manually operated unit is equipped with either pedestal stand or attachment for hydraulic yoke. Oil-impregnated bronze bearings provide lifetime lubrication. Parts are machined with sliding surfaces, precision ground for long life and freeness of operation.

Lovejoy Flexible Coupling Co.
Chicago, Illinois

Circle 133 on Reader Service Card

SINTERED FILTER

. . . for 1000 degrees F

Features: Capable of handling fluids to 1000 degrees F, filter can remove particles down to 1 micron from a wide range of fluids. Filter

has controlled permeability and uniform porosity which can be varied as to pore size desired. It can handle differential pressures of up to 500 psi.

Construction: One-piece sintered element can be made in a variety of diameters and lengths and its radial fin construction can be supplied in specified depths and numbers of convolutions to give extended area within a confined space. Varying flow rates are also available. Either internal or external threaded connections can be provided by the manufacturer. Threads are used as seals because of difficulties of packings at temperatures above 400 degrees F.

Purolator Products, Inc.
Rahway, N. J.

Circle 134 on Reader Service Card

GAUGE PROTECTOR

. . . for aircraft applications

Designation: Gauge Saver

Design: Protector is designed for use in a hydraulic, pneumatic, or fuel system having a maximum operating pressure of 10,000 psi. It is available for all shut-off pressures from 30 to 5000 psi.

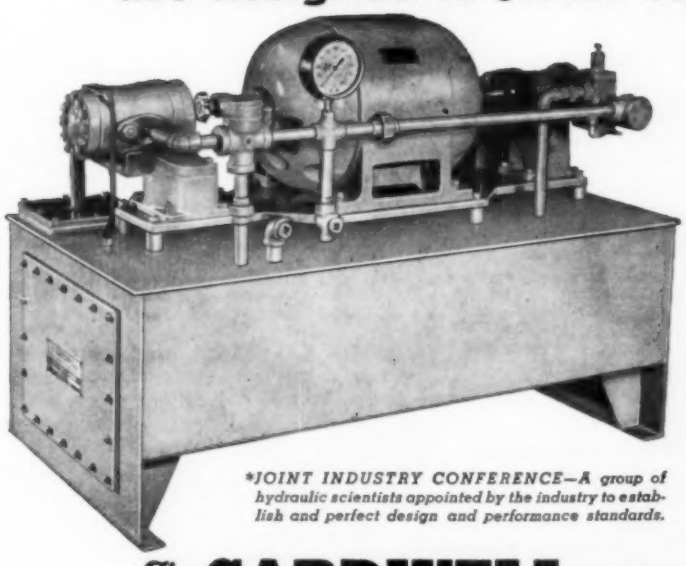
Specifications: Standard units with ¼-inch NPT gage connection

and ¼-inch NPT or AN inlet connection are made from aluminum or stainless steel.

Fisher Controls Co.
Santa Monica, Calif.

Circle 135 on Reader Service Card

CARDWELL HYDRAULIC PUMPS
are designed to J.I.C.* standards



*JOINT INDUSTRY CONFERENCE—A group of hydraulic scientists appointed by the industry to establish and perfect design and performance standards.

Here is what it means to you:

1. COMPLETELY SEALED TANK
2. SUBPLATE MOUNTING OF COMPONENTS
3. "OFF THE FLOOR" CONSTRUCTION
4. FILTER ACCESSIBLE FOR CLEANING
5. "QUICK CHANGE" DRAIN VALVE

You will get all these advantages with traditional quality when you buy Cardwell Hydraulic Power Pumps to operate all your presses. Cardwell Hydraulic Pumps are available in a wide range of

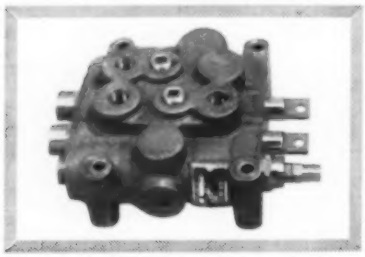
HP (Horsepower)	GPM (Gallons Per Minute)	PSI (Pressure Ranges)

The CARDWELL MACHINE COMPANY

FRANKLIN AT 19th STREET, RICHMOND 11, VA. Quality A CARDWELL TRADITION SINCE 1829

Circle 50 on Reader Service Card

HUSCO
HYDRAULIC CONTROLS
ARE SPACE-SAVERS



Here's new compactness in a multiple-purpose Hydraulic Control Valve—Husco No. 3600. Its simplified balanced design provides for single or double-acting plungers, individual check valves for each, adjustable relief valve with or without float position and alternate high pressure carry-over. Sizes, 5 to 60 gallons per minute.

Check HUSCO *first* for modern Hydraulic Units, and engineering aid on all your hydraulic developments. Write for details.

HUSCO HYDRAULIC UNIT SPECIALTIES CO.
Pumps • Valves • Cylinders
Waukesha, Wis.

Backed by more than a century's experience

BRITISH
Hydraulic Plant & Equipment
LEAD THE WORLD

Particulars of Members and their Products will appear in a future announcement.

The Hydraulic Association of Great Britain

•

94/98 Petty France, London, S.W.1. England
Telephone: Abbey 1845.

•

Cables: Crusade, Sowest, London

Useful Literature continued

AIR CONTROLS . . . A brochure from Lehigh Air Control Div. of Lehigh Foundries, Inc. reviews the various valves and air controls manufactured by the company. A rapid exhaust speed valve which allows air flow into or from a cylinder at a predetermined volume and speed is illustrated. The valve has an unrestricted port passage to permit quick exhaust, and can also be used on the exhaust end of a cylinder to retard speed of return stroke. A valve panel is shown comprising air gage, pressure regulator, lubricator, strainer, and four-way neutral position valve.

Circle 162 on Reader Service Card

SOLENOID VALVES . . . with low power consumption are detailed in a booklet published by Electro-Hydraulics Ltd. The booklet gives complete technical data, testing information, and describes and specifies the various types of valves available. A section of the booklet discusses pressure loss across an orifice giving calculations and graphs. Graphs are also presented for determination of rate of air flow through orifices, and weight of air per cubic inch for pressures up to 1000 psi. Schematic diagrams of the various valves are given with graphs indicating the flow characteristics.

Circle 163 on Reader Service Card

TEST EQUIPMENT . . . Sorenson Industrial Electronic Co. specializing in industrial test equipment built to customer specifications has issued a folder illustrating examples of their products. In the fluid power field the company has produced a static leak test stand and an air system test bench. The company specializes in the manufacture of hydraulic and electronic test equipment.

Circle 164 on Reader Service Card

ELECTRICAL CONTROLS . . . for two-hand operation of industrial machines are described in Catalog 65 issued by Micro Switch Division of Minneapolis Honeywell Regulator Co. The control equipment includes control boxes, hand switches, foot switch, limit switches and lock-out switch. One section covers clutch actuating equipment including electric solenoids, air cylinders, air valves and air-lube unit. Each unit of the package control systems is illustrated and specified. The control provides three safety features which are fail-safe operation, prevention of a power stroke of the machine during the set-up, and automatic reset feature which requires operation of all switches in the control circuit within a predetermined and adjustable time interval. All hands must be on the controls.

Circle 165 on Reader Service Card

TUBE FITTINGS . . . which eliminate flaring, threading, welding, or soldering are specified in a brochure from Lenz Co. To use the fittings it is not necessary to cut the tube to exact length or to have it square. There is no concentration of stresses due to flares or ferrules. Sealing is accomplished by an internal O-ring. Various tees, unions, elbows, and crosses are shown for tube OD's ranging from ¼ to 2 inches.

Circle 166 on Reader Service Card

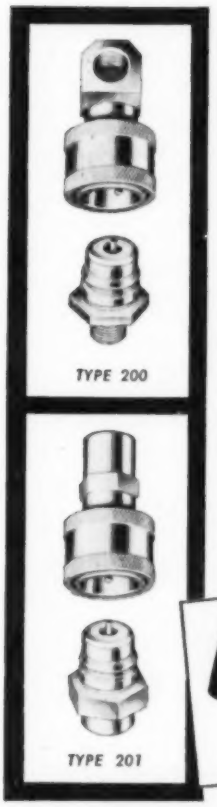
SOLENOID VALVES . . . A new 1-inch, 2-way valve and a midget size 3-way valve are presented in Form Nos. V5006 and V5010 from Automatic Switch Co. The 2-way valve is for control of highly corrosive gases and liquids and is made of heavy duty stainless steel construction. The valve has only two moving parts—a stainless steel core and a flexible diaphragm. The 3-way valve has new explosion-proof approvals and higher pressure ratings.

Circle 167 on Reader Service Card

AIR VALVES . . . which are solenoid operated are reviewed in Bulletin 5S-A published by Barksdale Valves. Four-way, three-way, and two-way valves for pressures of 250, 1000, and 1500 psi are included. The valves are specified according to current drain, minimum flow passage diameter, and free air flow at 1000 psi. Flow patterns are shown diagrammatically for each of the valve types and a photo-

Continued on page 102

Circle 32 on Reader Service Card



NEW miniature

QUICK-DISCONNECT COUPLINGS

Eastern's new couplings are the smallest available for high pressure systems. The lightest weight coupling made, Eastern units are used in pneumatic systems, and fluid systems such as hydraulic, and high pressure fuel.

SIZE: 2 3/16" overall length, .95" diameter

WEIGHT: 1.24 oz. (type 200); 1.17 oz. (type 201)

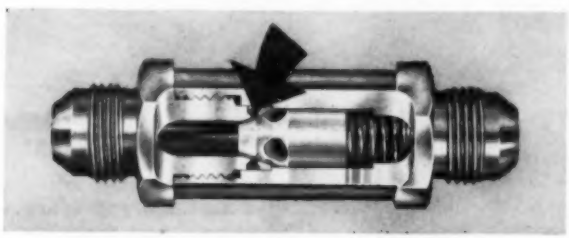
PRESSURE: 1500 p.s.i., maximum operating

FLOW: ½ g.p.m., normal

For detailed catalog sheet, write today.

Eastern
INDUSTRIES, INC.
100 SKIFF STREET
HAMDEN 14, CONN.

The FLEXIBLE SEAL SEAT*
Simple, Secure, Long-Lasting!



Responsive action of the soft O-ring seal provides absolute leak-tightness. Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts; no extra end seals. Stocked in 6 standard Dryseal pipe and JIC tube sizes; 12 connection combinations. Write for data sheet.

KEPNER PRODUCTS COMPANY
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Kep-O-seal

HYDRAULIC & PNEUMATIC
CHECK VALVES

* PATENT APPLIED FOR

Circle 56 on Reader Service Card

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CUSTOM MOLDING IN THIN SECTIONS

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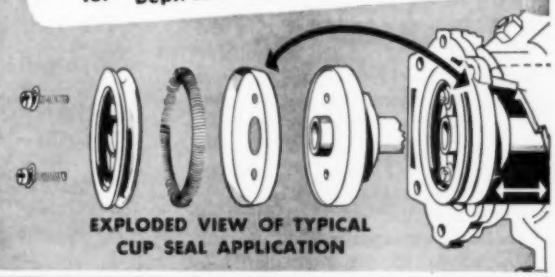
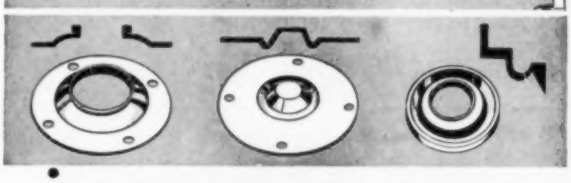


EXPLODED VIEW OF TYPICAL CUP SEAL APPLICATION



TEFLON'S unique properties

combined with our technique of custom molding TEFLON in thin sections and shapes, offer important advantages in product design.

- If you have a part now made of a flexible material which will not withstand severe conditions of temperature or corrosion, TEFLON is the answer. TEFLON is chemically inert . . . heat resistant (500° F or a −100° F) . . . has a very low coefficient of friction . . . does not absorb moisture.

Our trained engineers will work with you on any application of TEFLON Cup, Ball or Shaft Seals, Washers, Gaskets or Diaphragms to meet your exact requirements.

TEFSEAL SPARTA TEFSEAL

The first cost can be the least if it is the last cost

SPARTA MANUFACTURING CO.
DOVER, OHIO
Phone: 4-2755

Circle 85 on Reader Service Card

Useful Literature continued

graph is included to indicate dimensions. In the 3-way valve, ports are available for pressure, cylinder, and exhaust connections. Pressure is connected to the cylinder in either the energized or de-energized positions. In the alternate position, the cylinder is connected to exhaust. A 250-psi diverter valve to connect pressure alternately to two cylinders is also shown.

Circle 168 on Reader Service Card

TESTING MACHINES . . . are classified and discussed in Bulletin 4401 from Baldwin-Lima-Hamilton Corp. The hydraulic pumping system, the weighing system, and the indicating system are outlined for a typical unit. Construction and operation of various types of machines are shown in photographs and diagrams with accompanying discussions of the particular features. Machines range in capacity from 10,000 to 5,000,000 lb.

Circle 169 on Reader Service Card

V-BELTS . . . Much valuable information for designing multiple V-belt drives and maintaining them is included in a manual entitled "Care and Maintenance of Industrial V-Belts" published by B. F. Goodrich. The manual covers such subjects as designing the new drive; installation of belts; importance of tension; drive alignment; cleaning; storage; and others. A V-belt service chart illustrates typical causes of belt failure and photographs show failures caused by oil deterioration, cover fabric rupture, slip burn, ply separation, ruptured cords, etc. Methods of preventing these failures are outlined.

Circle 170 on Reader Service Card

AIR MOTORS . . . compressors, and vacuum pumps all of which incorporate a rotor and four sliding vanes are discussed in a brochure available from Gast Manufacturing Corp. The various units and combinations are illustrated, and performance graphs are presented. Centrifugal force holds the vanes tightly against the housing for an efficient, uniform seal. Air delivery or air motor power is thus continuous and pulseless. In addition to the basic units, bases, drives, and accessories permit a compact installation for many applications.

Circle 171 on Reader Service Card

HOSE AND COUPLINGS . . . Imperial Brass Mfg. Co. has published Bulletin No. 3040-A presenting their line of pressure hose and reusable couplings. Hose is for temperatures from —40 F to 275 F and is recommended for industrial and mobile applications. Instructions are illustrated showing methods for assembling reusable couplings and various types of hose including cotton-covered, single-wire braid; rubber-covered, single-wire braid; and rubber-covered, double-wire braid types. Angle swivel adapter unions are specified, as well as 45-degree and 37-degree flare fittings.

Circle 172 on Reader Service Card

O-RINGS . . . produced under laboratory controlled conditions to precise dimensions are specified in

GRESEN HYDRAULICS

VANE PUMPS

With Dual Vane Feed

For Mobile, Industrial, Agricultural Uses

SPECIFICATIONS
3-6-9-12-16-20-24 G.P.M.
Max. 2000 R.P.M.

ROTATION
Clockwise-Counter Clockwise
Mounting Feet Available

Write for literature

GRESEN MANUFACTURING CO.
628 Colfax Ave. N. Dept. H-16 Minneapolis 11, Minn.

Circle 43 on Reader Service Card

BACHMAN SOLENOID VALVE

MACHINE DESIGNERS!

Get the full story on Bachman's new long-life laminated plastic valves.

Built for consistent dependability, they will meet today's requirements for automatic machine control and give you the same satisfaction so many are now enjoying.

Ruggedly constructed valve body and base are made of light weight phenolic laminates which absorb shock and noise and are amazingly unaffected by wear. Standard O-ring seals are recessed in valve body.

Aluminum spool is micro-finished and hard coated by a sensational new process which maintains bubble-tight performance under most difficult conditions.

Stock models include ¼" pipe size in 2-way, 3-way and 4-way action, for pressures to 200 PSI.

You have your choice of single or double solenoid actuation in 110 or 220 volt continuous duty coils, with steel solenoid covers and safety connectors optional.

Consult your nearby distributor or write today for specifications which you can apply to your own automatic control problem.

Made and guaranteed by

JOHN D. BACHMAN & CO.
1713 Sparger Lane Bristol, Tennessee

Circle 13 on Reader Service Card

Technical Data Sheet No. 103 issued by Bacon Industries Inc. The sheet gives data for tensile strength, elongation, hardness, compression set, brittleness, color, and suitability for use with food. Dimensions are also given with the explanation that the O-rings are made in special dies which allow for the higher shrinkage factor encountered with silicone rubber. Also released by the company are price sheets, lists of molds available, and specifications for their recently developed compound X-5-8, a Teflon-silicone compound.

Circle 173 on Reader Service Card

ADJUSTABLE SPEED DRIVE... Hydraulic feedback drives for continuous process machines require precision techniques for measurement of performance. To describe equipment which has been developed for this purpose at The Oilgear Co. the company has issued a reprint of the paper entitled "Performance Measurements of Oilgear Hytac Precision Drives." The paper discusses measurement of steady state system accuracy and transient and frequency response data. The last two measurements give information for use in verifying theoretical system analysis and indicating how rapidly the system corrects for error producing changes.

Circle 174 on Reader Service Card

EXPLOSIVE VALVES . . . which operate by firing a small completely contained explosive charge are the subject of Catalog 5501-XV published by Conax Corp. The catalog illustrates various styles of the normally-open or normally closed valves. The normally-closed type provides dead-tight shut-off before firing and may be used for long term storage of gas or liquid under high pressure. On firing it opens in .002 seconds. The normally-open type stops flow in .002 seconds when the charge is fired. Either model is good for only one cycle and cannot be used again. Operation of the valves is diagrammed, and specifications are listed.

Circle 175 on Reader Service Card

AIR REGULATING EQUIPMENT . . . including filters, lubricators, moisture collectors, and dehumidifyers are detailed in Bulletin No. 75 from Perfecting Service Co. A simple description and table of overall dimensions is given for each type of unit and a paragraph describes its outstanding features. Cutaway photographs illustrate design and construction features. The catalog includes information on aluminum filters for use on large size pipe lines where plastic bowl filters are not adaptable due to pressure or temperature.

Circle 176 on Reader Service Card

SHAFT SEALS . . . are detailed in an attractive booklet from The Garlock Packing Co. Cutaway illustrations and sectional drawings clearly indicate the constructional features of the seals, and recommended service is outlined for each type. The seals have a one-piece assembly with the entire unit including gland ready for quick installation. The seals are preset at the factory and no on-the-job measurements or adjustments are necessary. The seals have no set screws to loosen, corrode or damage the shaft or shaft sleeve.

Circle 177 on Reader Service Card

TEFLON HOSE . . . with detachable, reusable fittings has been announced by Aeroquip Corp. in Bul-

Continued on next page

use JOY SURGEPRUF

... THE NON-SKIVE COUPLING WITH THE DOUBLE-WEDGE GRIP

PERMITS THE USE OF MORE ABRASION-RESISTANT, RUBBER-COVERED HOSE

Insure longer wear in your hydraulic hose assemblies—and at the same time, save assembly time by avoiding old-fashioned skiving. Joy Surgepruf re-usable couplings make *both* advantages possible. Their exclusive "double-wedge" grip lets you use tough, abrasion-resistant, rubber-covered hose instead of the braided type—without any need for skiving the hose at the connection.

NO SPECIAL ASSEMBLY TOOLS REQUIRED

You need no mandrels or other special tools to make up Surgepruf assemblies. No extra expense or special technique is involved.

CAN BE RETIGHTENED WHEN LOOSE ON THE HOSE

Machine vibration or hose flexing can loosen any hydraulic coupling on the hose in time, but Surgepruf Couplings can be easily, quickly retightened on the job to stop a leak—*another* exclusive feature.

Surgepruf Hose Couplings are made to JIC Standards. Assemblies are available in many sizes and lengths, and in both single and double-wire reinforced types for medium-high and high pressure service respectively. *Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*

Get complete data on Surgepruf: WRITE FOR BULLETIN H-100a

Consult a Joy Engineer

W&D H5506

JOY

HYDRAULIC ASSEMBLIES THAT GIVE YOU MAXIMUM RELIABILITY

Circle 54 on Reader Service Card

You Can Have DRY AIR

with EXACT moisture control at any time of the year

. . . for your Comfort
. . . for your Process
. . . for the protection or testing of your machines or your materials

Assembling Electronic Parts

Packaging Food Products

This NIAGARA METHOD gives you the *most effective* air conditioning because its cooling and heating functions are completely separated from the addition or removal of moisture. Therefore, you always get a precise result. You can reach and hold any condition, or vary it as you wish, without having to rely on moisture-sensitive instruments.

It is *easy to take care of.* All parts of the equipment are accessible. The control circuits are simple. It removes moisture by absorption, yet there are no salts or solids or solutions of solids to be handled.

It is *inexpensive to operate.* It does a large amount of work in a small space. At normal operating temperatures, since it absorbs moisture directly without refrigerating below the required dew point, there is no re-heating.

Write for full information; ask for Bulletin 112. Address Dept. AH

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N.Y.
District Engineers in Principal Cities of U. S. and Canada

Useful Literature continued

letin AEB-9 giving technical information about this equipment. The hose has a Teflon inner tube and a specially designed detachable, reusable fitting. The oustanding characteristics of this assembly are ability to withstand temperatures from —100 degrees F to +500 degrees F, unaffected by acids or other deteriorating fluids, light weight, and small size. The fitting can be removed and installed without the use of any special tools, permitting quick installation and repair. The fittings swivel 360 degrees, so that they can be rotated to the exact position required as the hose assembly is installed. The company has also issued Industrial Engineering Bulletin No. 3 to present their line of split-flange hose fittings. Available in straight, 45, and 90-degree assemblies.

Circle 178 on Reader Service Card

SPHERICAL UNION CONNECTION . . . which compensates for 10 degrees misalignment in any direction is introduced in drawing GD-918 released by Jerguson Gage & Valve Co. When used with a side-connected gage, the spherical union on the tank connection side of the valve permits a variation of ±3/8 inch or a total of 3/4 inch increase or decrease on centers. The use of a spherical union also compensates for a tapped hole drilled at an angle other than a true right angle to the mounting plane. The spherical union feature is also useful where a scale is fastened to the gage and it is necessary to position a given graduation at a definite elevation with respect to the liquid level.

Circle 179 on Reader Service Card

MOLDED TEFLON . . . "Sparta Reports on Custom Molded Teflon" is the title of a new brochure available from The Sparta Manufacturing Co. The brochure contains many graphic illustrations of the various applications of Teflon such as cup, ball, and shaft seals; washers, gaskets, and diaphragms. The company specializes in custom molding of thin sections and shapes.

Circle 180 on Reader Service Card

STATIONARY TACHOMETERS . . . which have no brushes, slip rings, or other parts that need regular maintenance are featured in Metron Instrument Co. Bulletin No. 105. This presents the company's complete line of indicators and takeoff heads, and indicates several typical applications for the instruments. The units have accuracies up to 1/4% of the speed being measured and take two to ten times momentary overspeeds depending upon range. Other speed control instruments include an overspeed and underspeed control, a speed recorder, and a three-range indicator.

Circle 181 on Reader Service Card

AIR OPERATED VALVES . . . which are either solenoid or air controlled are illustrated and described in a data sheet from Lehigh Foundries, Inc. Either 3 or 4-way types are available in sizes of 1/4, 3/8, and 1/2 inch. Solenoid controlled types are made for 10 or 110-volt operation. The valves are equipped with dual air supply inlet ports to facilitate extreme high speed requirements. The solenoid controlled types can be converted to air controlled types.

Circle 182 on Reader Service Card

TEMPERATURE CONTROLS . . . with ranges from sub-zero to 1800 F are reviewed in Catalog G-20 available from Burling Instrument Co. The controls are designed for accurate and reliable temperature regulation, and for high or low temperature alarms and cut-outs. Various models for application to electrical and pneumatic control systems are illustrated. An instrument selection chart summarizes the features of the controls.

Circle 183 on Reader Service Card

COUPLING . . . for flexible hose is outlined in Bulletin 240 prepared by Snap-Tite, Inc. The bulletin describes the "H" coupling, its uses and construction. This is a new quick-connect, quick-disconnect unit incorporating an exclusive U-packer which gives positive seal without compression set because of rubber distortion. To aid engineers, a fully detailed cut-away of the coupling is incorporated in the bulletin. Complete dimensions and ordering information for spare parts and complete couplings are included.

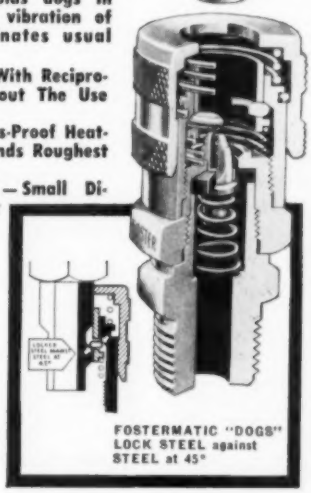
Circle 184 on Reader Service Card

Circle 38 on Reader Service Card

THE FOSTERMATIC "BULLDOG" GRIP
"Dogs" are contoured to grip 41% of plug locking surface.

FOSTER *Matic*
QUICK DETACHABLE
COUPLERS

- "Floating Carrier" holds dogs in position and absorbs vibration of pulsating air. Eliminates usual housing wear.
- Can Be Used Directly With Reciprocating Air Tools Without The Use Of Lead Hoses
- Chrome Sleeve is Stress-Proof Heat-Treated Steel. Withstands Roughest Treatment.
- Greater Air Capacity — Small Diameter — Light Weight



FOSTERMATIC "DOGS" LOCK STEEL against STEEL at 45°

Here's a coupling that's suitable for 90% of all uses. Snaps on — snaps off. Delivers 49% more air. Write for new descriptive Bulletin FMC.

FOSTER MFG. CO. Inc.
2850 Gravois 13-C
St. Louis 18, Mo.

Circle 12 on Reader Service Card

SOLENOID OPERATED AIR VALVES

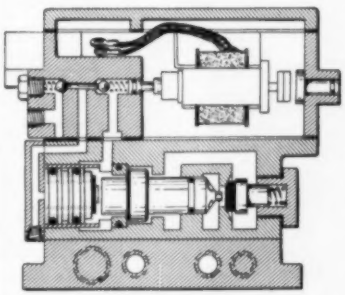
designed to

J.I.C.

standards

1/4" - 3/8" - 1/2" - 3/4"

4-Way—Model 441



FEATURES

A—Manual Operating Button

B—Water-tight and Dust-tight Solenoid Enclosure with built-in Electrical Junction Box.

C—Cover chained to Body

Write for Information—Prices

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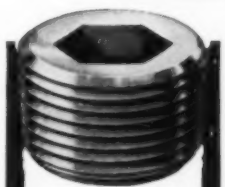
37419 Grand River Ave. • Farmington, Mich.

3000 psi won't get by the threads of Allen ○ Dryseals!



ALLEN 'TRU-ROUND' Dryseal Pipe Plugs

formed from special analysis ALLENOY steels.

Sold only through leading industrial distributors — specify genuine Allen Dryseal Pipe Plugs.

standard sizes from 1/16" to 1-1/4"

Here's the dependable, metal-to-metal seal you need for hydraulic systems . . . for transmission, control, and automated mechanisms where pressures run high. The N.P.T.F. threads of Allen ○ Dryseal Pipe Plugs are smooth, burnished, and burr-free — do their job without any help from sealing compounds. Allen's unique "pressur-forming" process assures the highest degree of precision threading and dimensional accuracy. What's more, Allen ○ Dryseals are precisely round at root, pitch and crest, with taper held to extremely close tolerances.

Allen engineers will gladly help you to harness your hydraulic pressures. Just write.

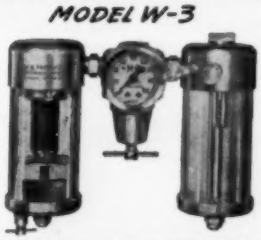
ALLEN HEAD

ALLEN
MANUFACTURING COMPANY
Hartford 2, Connecticut, U. S. A.

3 in 1 GUARD of the AIR LINE

M·B

WHIRL-A-WAY
FILTER-REGULATOR and LUBRICATOR ASSEMBLY
MODEL W-3



the BEST PROTECTION TO YOUR AIR-VALVES, CYLINDERS, PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00039 and larger. TRANSPARENT BOWL provides visibility. REGULATOR capable of passing large volume with unrestricted flow and minimum pressure drop. LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

ANY OF THESE 3 DEVICES CAN BE USED AS SEPARATE UNITS OR IN ANY COMBINATION

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DETROIT 3, MICHIGAN

Circle 5 on Reader Service Card

Circle 61 on Reader Service Card

Post Scripts of Industry

News about people, manufacturers and sales organizations

John A. Carver
Precision Rubber Products Corp.

George R. Anderson
The Weatherhead Co.

R. K. Grobholz
Worthington Corp.

Precision Rubber Products Corporation have assigned **John A. Carver** as distributor field supervisor. Carver will serve in a technical sales capacity and will work with distributors of the company's products all over the country. He had several years experience in sales and service work at the company's Dayton plant.

George R. Anderson, who until recently was special products manager in charge of the new hose swaging program of the **Weatherhead Company,** has been promoted to industrial original equipment sales manager. He will be responsible for all sales and service functions of this division and will maintain his headquarters at the newly established Fort Wayne division offices.

Standard Pressed Steel Company has added **Joseph W. Fribley,** president of Cleveland Cap screw Company, and **Homer H. Marshman,** senior partner of Marshman, Hollington & Steadman, to its board of directors.

R. K. Grobholz has become manager of the **Worthington Corporation** Power Pump Sales Division. He succeeds **A. F. Welsh** who was appointed manager of the marketing research division. Grobholz, a specialist on hydraulic systems for presses will headquarter at the Corp.'s Oil City, Pa., Works.

A regional office of the Technical Service Division of **The Texas Company** has been opened in Atlanta, Georgia. The new facilities will increase Texaco's direct services to this important southern industrial section. Located at 873 Spring Street, N.W., the new service headquarter is under the direction of **J. F. Collins, Jr.** He joined the organization in 1929 and his most recent post was technologist in the company's Houston office.

Greer Hydraulics, Inc., named **Norman H. Schwarz** as manager of the company's machine shop, which is now doing special contract work for outside companies and serving the needs of the company's production, engineering, research and service departments.

Designed to serve the South and Southwest area, **Aeroquip Corporation** have opened a new warehouse in Dallas, Texas. Located at 102 Express Street, this new office will be managed by **Clyde Stratton,** previously of the production control department at the Jackson plant.

Woodrow L. Lacey has become West coast district manager for the Coupling Division of the **Sier-Bath Gear & Pump Company, Inc.** He will headquarter at the San Rafael, California office

Continued on page 108

Circle 74 on Reader Service Card

Quality HYDRAULIC PACKINGS

NEOPRENE-FABRIC COMPOUND & HOMOGENEOUS

"V" CUPS
"U" FLANGE
"O" RINGS

Periflex Inc.

HAZEL PARK • MICHIGAN

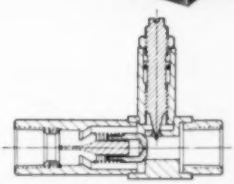
Circle 37 on Reader Service Card

DEPENDABLE

RESTRICTOR VALVES

- **CAN'T STICK OPEN** due to dirt in oil
- **HOLDS ADJUSTMENT** will not leak
- **STRONG** burst pressure over 10,000 P. S. I.
- ¼", ⅜", ½" and ¾" pipe sizes
- For oil at pressures to 3,000 P. S. I.

Write or phone Mentor, Ohio, Blackburn 5-2625 for complete specifications.



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Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO
Member Of The National Fluid Power Association

Control Gases to 10,000 P.S.I.

WITH VICTOR GAS-O-DOME REGULATORS

Gas pressure, not springs, control diaphragm motion to give you precise regulation of high-pressure gases at high or low flow rates. Can be remotely controlled if desired. Safety valve furnished on request. More than 55 stock models in the following series:

GAS-O-DOME SERIES	DELIVERY RANGE (p.s.i.)	SPECIAL FEATURES	GASES HANDLED
GD 30	0-2500	High Delivery Flow Rates. Accurate Valve Control.	Air, Argon, Helium, Hydrogen, Nitrogen, Oxygen —and others non-corrosive to bronze and stainless steel.
GD 31	0-3600		
GD 61B	0-2500	Excellent Capacity. Compact— 7 lb.— 4" x 6" x 6". —67° to +160° F. Range.	
GD 62B	0-3600		
GD 80	0-5000	Accurate Valve Control. —67° to +160° F. Range.	
GD 81	0-10000		
GD 10	0-500	Self-Relieving Pilot Regulator Control. High Flow Rates.	
SR 10	0-1000	High Pressure, Low Flow. Compact—4 lb. —2" x 6" x 6".	
SR 100	0-30 & 0-40	Corrosion Resistant.	Ammonia (wet or dry) Boron Trifluoride Chlorine (wet or dry) Hydrogen Sulfide, Hydrogen Chloride, Sulfur Dioxide—and other corrosive gases.

VICTOR'S LONG EXPERIENCE IN PIONEERING HIGH PRESSURE GAS REGULATION *is yours for the asking. For details, and complete data on Gas-O-Dome Regulators, see your VICTOR dealer or write us for catalog 341. Dealer inquiries invited.*

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment, hardfacing rods, blasting nozzles; cobalt & tungsten castings.

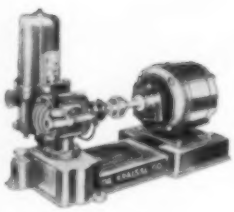
844 FOLSOM ST. • SAN FRANCISCO 7 21

Circle 98 on Reader Service Card

• Since 1926 • In the application, design and manufacture—pumps, separators, hydraulic accessories.

EQUIPMENT FOR FLUID POWER TRANSMISSION

Primary Oil Pumps • Vacuum Powered Transmission and Low Pressure Air Service • Air and Liquid Filters •



Rotary Air Pumps for vacuum bottling

Kraissl's patented, automatic, force-feed lubrication and flushing system makes these direct-drive, high-capacity pumps ideal for the special requirements of bottle-filling machinery.

Air-cooled design—or water-cooled models for heavier duty.

Class 21 roller-action pumps are recommended for handling corrosive gases and extraneous matter that might jam with closer clearances. The multi-blade design of the Class 25 pumps gives higher capacity efficiencies and is designed for applications requiring higher degree of vacuum.

Where water-cooling is desired for continuous service, the water-jacketed Class 25-WJ models are recommended.

Our exclusive Class 26 design air filter can be furnished as an integral part of each pump, up to 10 cfm—to produce oil-free discharge air and also conserve the lubricating oil.

Write today for Bulletin A-1289, for air-cooled pumps—and for A-1523 for the water-cooled models.

KRAISSL CO. Inc.
366 Williams Ave., Hackensack, N.J.

Post Scripts of Industry

continued

and will cover the states of California, Washington and Oregon. Lacey had many years of engineering and sales experience, and formerly owned and headed his own organization.

George E. Carlson, former vice president in charge of sales has been elected president of **Minnesota Rubber and Gasket Co.** He will also hold the post of secretary. The new vice president and treasurer is **Robert W. Carlson,** who was previously vice president in charge of production.

George E. Carlson
Minnesota Rubber & Gasket Co.

Robert W. Carlson
Minnesota Rubber & Gasket Co.

Servomechanisms, Inc., appointed **Ralph W. Barnes** to the position of customer liaison manager of company's eastern division. He was previously contract manager of the Electronics Corporation of America.

Automatic Switch Company appointed **Equipment Sales Company,** 164 East Exchange St. Akron, Ohio, and **Washburn-Garfield Company,** Foster and Commercial Sts., Worcester, Mass., as stocking distributors in their respective industrial areas. The company also named the **Pierre Lenmark Company,** 6518 Walker St., Minneapolis, Minn., as representatives.

Cook Electric Company has opened a new district office 21015 Lorain Avenue, Fairview Park, Cleveland 26, Ohio.

Dr. Robert T. Armstrong was elected vice president-technical director of **Celanese Corporation of America.** He has been associated with Celanese in various technical capacities since 1946. Before joining the company, Dr. Armstrong taught at the Massachusetts Institute of Technology.

Paul Azzolina, since 1936 with the **Le Roi Division, Westinghouse Air Brake Co.,** was named manager of the service department. He will be responsible for supervising field servicing of all Le Roi products, maintaining the parts department, and publication of service bulletins and parts catalogs.

Paul Azzolina
Le Roi Division,
Westinghouse Air Brake Co.

The following officers were elected by the **National Industrial Leather Association** to serve for 1956: President—**J. N. Smith,** E. F. Houghton Co.; Vice president—**John R. Lovett,** Cleveland Oak Belting Co.; Treasurer—**A. B. Laurence,** Laurence Belting Co. Officers elected for the Mechanical Leather Packing Division are: Chairman—**Alfred S. Berens,** Chicago Rawhide Mfg. Co.; Vice chairman—**Wm. C. Merritt,** Simplex Manufacturing Co. The Association also elected these three new directors to its board: **Edward H. Ball,** Chicago-Allis Mfg. Corp.; **Nathan Fried,** Johnson Belting Co.; and **Philip G. Rhoads,** J. E. Rhoads & Sons.

H. Thomas Hallowell, Jr., president, Standard Pressed Steel Company, was elected president, and **Van H. Leichliter,** vice president of operations of American Steel and Wire Division of United States Steel Corp., was elected vice president of the **American Standards Association.**

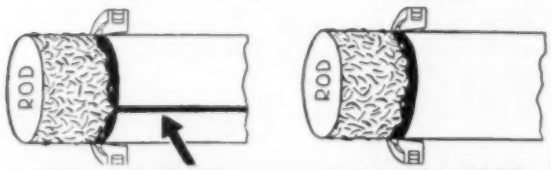
The **S-P Manufacturing Corp.,** of Cleveland are constructing a new plant in Solon, Ohio. The new facilities, to be ready in May will make possible improved service to the expanding list of customers. Executive offices as well as engineering and manufacturing operations will be transferred to the new location.

Malcolm W. Black Co., have become the representative for **Chiksan Company,** with territory comprising of southern New York and northern New Jersey. The company's headquarters are in New York City.

Four executive appointments have been announced by **Robertshaw-Fulton Controls Company. Woodford D. Miller,** vice president and the general manager of the Robertshaw Thermostat Division, has been made executive vice president in charge of the company's eastern operations. **Frank H. Post,** assistant vice president, succeeds Miller as vice president and general manager of the Robertshaw Thermostat Division. **George Metz** has been named assistant to the general manager and will be in charge of

Continued on next page

This or This?



OPEN JOINT PERMITS A STREAK OF DIRT AT JOINT OPENING

"CJ" WIPER'S CLOSED JOINT KEEPS THE ENTIRE ROD CLEAN

For those dry operations requiring absolute freedom from dust or dirt passing through joint of ring to bearings or packings, we have especially designed—the

FALL WIPER RING with Closed Joint
(our P/N-FWR-CJ)

In addition to the above, and since 1944, we have also manufactured **For Army and Navy Use** the 3 Piece **FALL WIPER RING FWR-3C**
Spec. Mil-S-5049, AN Approved, Military part numbers from AN6231A1, ½", to AN6231A71, 13", diameter. This ring consists of 3 pieces assembled into one . . (1) a one-piece Split Wiper Ring (Body) with 2 flanges or groove in its O.D.; (2) a one-piece split compressor spring assembled in groove (3) an endless cover band surrounding spring in groove which causes squeeze grip action on piston rod.

Squeeze Grip Action Does It—patented

—and squeeze grip is always the same because uniform tension of spring under endless cover band. Rods or pistons do not stick or become immobile in ANY temperature.

Our engineers will gladly work with you on any wiper ring problem. Write, wire or phone us.

Ace Products Co., Toledo 1, Ohio
Phone Cherry 36513

Fall Wiper Ring SPRING LOADED

Covered by patents issued and patents pending.

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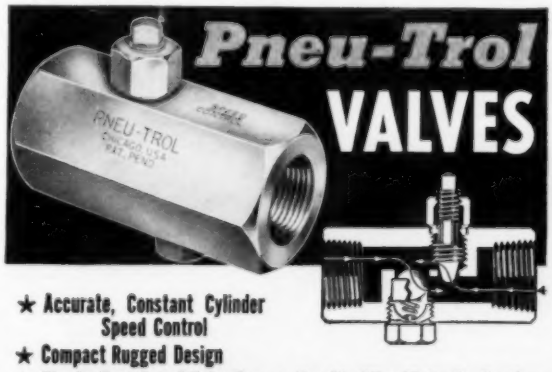
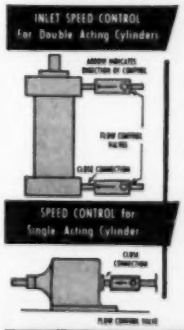
Pneu-Trol VALVES



★ Accurate, Constant Cylinder Speed Control
★ Compact Rugged Design
★ Simple, Easy Speed Selection ★ For Air, Oil or Water Applications



Pneu-Trol Speed Control Valves, are widely used in hundreds of control applications because they combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to its seat, requiring only a slight differential pressure to fully open or close it.

Needle design permits maximum flow capacity in the controlled direction. Metal to metal needle and ball seats insure long trouble-free service. Simple, practical "O" gland structure eliminates troublesome leaking. Valve bodies machined from hex brass or aluminum for 2000 psi working pressures; steel and stainless steel for 5000 psi. Made in 5 female pipe sizes—⅛" to ¾". ATTRACTIVE PRICES . . . IMMEDIATE DELIVERY.

Write for illustrated circular and prices.

Pneu-Trol DEVICES, INC.
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Post Scripts of Industry
continued

manufacturing at that division. **Freeman G. Cross,** vice president will succeed Jean V. Giesler, who has retired, as general manager of the Fulton Sylphon Division.

Coming
March 19-23
The best and latest in tools, machines, inspection equipment, automation devices, controls and accessories to cut costs and boost profits—many never before shown anywhere.
• For the small plant
• For the intermediate plant
• For the big plant
1956 ASTE INDUSTRIAL EXPOSITION
INTERNATIONAL AMPHITHEATRE
CHICAGO, ILL.
AMERICAN SOCIETY OF TOOL ENGINEERS
10700 Puritan
Detroit 38, Michigan

Charles K. Stiles
Flex-O-Tube Division

Flex-O-Tube Division of Meridan Corporation has appointed **Chester L. McCormick** as East Coast sales representative to supervise sales in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware and Maryland. He was formerly a sales representative for the Weatherhead Company. **Charles K. Stiles** has become Midwestern district sales representatives and will be in charge of sales activities in northern Illinois, Wisconsin, Minnesota, Iowa and Nebraska.

Chester L. McCormick
Flex-O-Tube Division

The appointment of **Lee Wilson** as manager of the Air Compressor Division was announced by **Bell & Gossett Company.** He joined the company's sales organization in 1954 after five years with the Gerbing Mfg. Corp. as their general sales manager.

Low-cost ready-made hydraulic tanks

top-notch DESIGN
large top SURFACE
a complete LINE
all tanks IN STOCK
ALL WELDED construction
write today for CATALOG

Rosaen Reservoirs do away with makeshift, unsightly home-made construction, give you instead a ready source for standardized, properly engineered reservoirs and all mounted accessories. Produced in volume, the price beats building or buying them to special order. All parts carried in stock.

The Rosaen Company will also assemble complete power units to order, and supply all hydraulic components if desired.

The ROSAEN COMPANY
24601 HARPER • ST. CLAIR SHORES, MICHIGAN

HONED Stainless Steel ROD ...at NO extra cost

At no increase in price, **AIROYAL** small (1", 1½" and 2") bore air and oil cylinders—always a good buy—have been even further improved. You'll buy them now with satin-smooth, externally honed, stainless steel piston rods. No more rust on rods, pitting or other surface imperfections. You'll enjoy the substantial increase in rod packing life. And look—price of 1" x 1" cylinder, for 150 PSI air or 1500 PSI oil service, is still only $27.00 list. **Write for catalog and prices.**

MANUFACTURED BY
THE AIROYAL CO.
1990 SPRINGFIELD AVENUE
MAPLEWOOD, N. J.
REPRESENTATIVES IN PRINCIPAL CITIES

Circle 81 on Reader Service Card

Circle 4 on Reader Service Card

COLD WEATHER OPERATION

Concluded from page 68

ature operation include the oil reservoir, filters, pump speed and system plumbing.

Where frequent low temperature start-ups are anticipated, it may be advisable to equip the reservoir with heating coils or a heating jacket.

Non-bypass filters present a low temperature problem because they may impede oil flow through their small passages, especially if the passages are partially blocked with contaminants and oil deterioration products. Filters on the intake pipe may cause insufficient feed of viscous oil to the pump, while a non-bypass filter on the discharge side of the pump may cause large pressure drops followed by possible collapse or channelling of the filter.

One manufacturer of construction equipment provides for low temperature start-up with a hand controlled bypass line around the filter mounted in the intake line. After the oil in the system has warmed up, the full oil flow is routed through the filter.

Pump Speed: Here's an important variable which affects pumping efficiency as viscosity increases. As a pump of given size and design is speeded up, it becomes less efficient and tends to cavitate with high viscosity oils because of the friction losses in pump inlet ports or valves. Reduced pump speeds for starting up a cold system may be achieved in practice by intermittently turning the pump drive motor on and off until the oil in the system is partially warmed and flowing properly. ▼▼▼

NEED AN EXPLOSION-PROOF CIRCUIT?

Concluded from page 47

equipment for use in hazardous (Class I, Group D) locations.

Solenoid enclosure and connection: All electrical connections must be in a metal enclosure which is capable of withstanding the internal pressure resulting from explosions without bursting or loosening its joints. Joints in the enclosure must be the metal-to-metal type. The Underwriters' standard established the amount of clearance for a given joint width; measurements for bolt space and location, and dimensions for shaft openings.

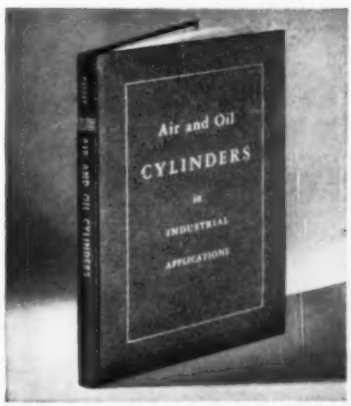
The valve must be designed so that rigid conduit having threaded joints is used. All openings for connections to conduit must have at least five full threads, and sealing compounds must form a tight and practically permanent seal under service conditions.

Air pilot valves: Using a small diaphragm type air cylinder to position a valve spool is illustrated by the cutaway drawing, Figure 1. Not only is this control explosion-resistant, it also is a practical way to obtain the necessary force to move a spool in a large valve. Construction of a 2-inch shut-off valve is shown in Figure 1.

While there has been some effort to provide explosion-proof valves, future work in this area will depend upon how much demand there is for such equipment. ▼▼▼

AIR and OIL CYLINDERS in INDUSTRIAL APPLICATIONS

By E. F. Heiser



Design and production men who have this book are saying . . .

"A fabulously rich mine of practical information."
"Admirably down to earth."
"Certainly the most readable book devoted to the subject of pneumatic and hydraulic power cylinders."
"Will interest the maximum number of readers."
"Theory and technical explanations are clearly and concisely presented."
"The essence of the book is that it manages to be at one and the same time forceful, amusing, easy on the brain and, not least, a valuable treatise on a little documented subject."

These are the reasons why an increasing number of copies are now being sold as repeat orders.

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Remittance enclosed ☐; Bill our company ☐ Bill me ☐

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What a sight!

CENTURY'S

All-new Oil Level Sight Gage

- No Easier Installation Ever Designed
- Better Visibility at any Height
- Leak-proof—No Dripping
- Streamlined Modern Appearance
- Important Savings in COST
- Available NOW From STOCK

Inquire today . . . make immediate use of the sensational advantages in cost and services offered by this new gage . . .

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THE MARKET PLACE

SALES ENGINEERS—WEST COAST

Expansion creates outstanding territories in Seattle, San Francisco and Los Angeles. We are the exclusive distributors for nationally known top air and hydraulic lines. Large local inventories maintained. Our own top flight engineering department and shops design and build special machinery. Applicants, not over 40, must have technical and sales background in field of applied air and hydraulics for industry. Substantial salary plus commissions and expenses with well developed territory offered. Resumes will be handled in confidence. Local interviews arranged. Write C. J. Woodward, V.P., The Rucker Company, 4700 San Pablo Avenue, Oakland 8, California.

WANTED—SALES ENGINEER

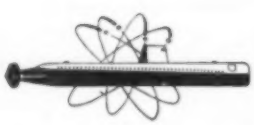
To assist manufacturers representative in Illinois selling established lines of hydraulic equipment. Opportunity to join organization. Write full details to Box 2156 APPLIED HYDRAULICS.

MANUFACTURER'S AGENT WANTED

Qualified to represent a prominent manufacturer of patented air and hydraulic cylinders. Our merchandising program allows you to set up distributors, quote OEM's, meet and beat competition. All territories open. Please give method of operation, territory covered, lines handled and any other pertinent information about your operation. Box 2256 APPLIED HYDRAULICS.

MECHANICAL ENGINEERS

What Should an ME Know About Atomics?



Quite a bit these days, with so many companies getting into the field. While many new firms are now starting to explore the field, Electric Boat Division of General Dynamics Corporation led the way with the building of the first nuclear powered submarines, Nautilus and Sea Wolf.

In addition to increasing its engineering force for work on new and greatly advanced nuclear submarines, Electric Boat is expanding Research and Development operations to include the development of additional practical uses for nuclear energy.

Right now Electric Boat has interesting positions for Mechanical Engineers with experience in vibration and shock, machine design, stress analysis, hydraulics, rotating machinery, power plants or air-conditioning and piping.

Study for bachelor's or advanced degrees is encouraged at Electric Boat, with courses in mathematics, naval architecture, nuclear engineering and nuclear submarine systems offered within the plant, and tuition paid by the company for study in these or other fields at leading colleges and universities.

Men interested in these openings should write complete details of background and experience including initial salary requirements. Interviews will be arranged promptly for qualified applicants. Address Mr. Peter Carpenter.

Electric Boat Division
GENERAL DYNAMICS CORPORATION
GROTON **CONNECTICUT**
near New London on the Connecticut shore

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Febraury, 1956

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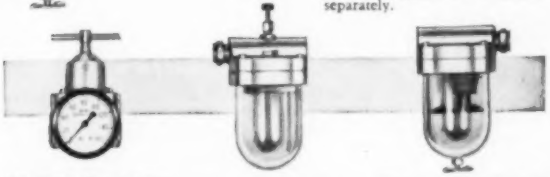
AIR-MITE
FILTER—REGULATOR
Oil Unit

- Instantaneous response to demand
- Special Filter for cleaner air
- Accurate injection of pre-atomized oil

The new AIR-MITE unit is designed and built for maximum operating efficiency, easy maintenance and long life Operates at pressures to 160 psi. Available in ¼", ⅜" and ½" T.P. sizes. Individual units available separately.



Regulator—Incorporates piston cup instead of diaphragm. Provides more accurate, stable regulation, lasts longer. Direct reading gauge for close regulation of outlet pressure.

Lubricator – Automatically pre-atomizes and feeds oil mist into air stream. Simple micro adjustment permits accurate balance of oil-to-air supply.

Filter – Porous sintered bronze element filters better . . . won't collapse . . . is easy to clean. Built in air baffle. Brass drain cock.

Write for catalog sheets and prices.

AIR-MITE Devices, Inc.

4415 W. CARROLL AVENUE • CHICAGO 24, ILLINOIS

Circle 3 on Reader Service Card

MAYSON HOSE SWIVELS

WHY HOSE SWIVELS?

Because a swivel joint attached to rigid pipe just does not have a fair chance. Misalignment will ruin the best of bearings and packing too.

Hydraulic hose and Mayson Hose Swivels are a natural team. Each relieves strain on the other and you save on both—less hose length and a lower priced swivel.

There is an alert Dealer near you who sells both.

J.I.C. Standards
Sizes ¼" to 2" P.T.
Male or Female

MAYSON MFG. CO.

4332 Horatio Street • Detroit 10, Mich.

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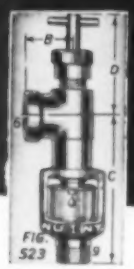
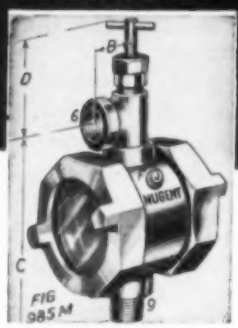
See...Don't Guess

Install NUGENT Sight Feed Valves for LUBRICATION CONTROL



13 models designed for working pressures to 125 psi. Sizes to ¾ inch.



9 models for large machinery. "Swivel and lock" type for sight chamber adjustment to most convenient view position.

Medium size needle type with steel valve stem. 9 models. Sizes to ¾ inch.

WITH a Nugent Sight Feed Valve in your oil line, you can tell at a glance whether or not vital parts are receiving proper lubrication. Nothing is left to chance and there's no guess work involved. Oil flow through the valve is controllable from 2 drops per min. to 21 gals. per hour depending upon oil viscosity and valve model. All are vented to prevent air binding. Glasses and screens are removable for cleaning without interrupting oil flow.

SIGHT FLOW INDICATORS

Sight Flow Indicator available with tapped or flanged connections. Removable windows. Can be installed right or left hand or vertically.

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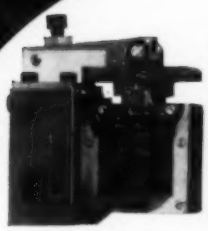

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